سركت

SERKET

The Arachnological Bulletin of the Middle East and North Africa

Volume 17 **Part 4**

May, 2021 **Cairo, Egypt**

****

ISSN: 1110-502X

SERKET

Volume 17 Part 4

May, 2021 Cairo, Egypt

Contents

Page

New considerations on the *Leiurus* Ehrenberg (Scorpiones: Buthidae) distributed in Africa and description of a particular species from Egypt
Wilson R. Lourenço & Hisham K. El-Hennawy 325

A particular new species of *Orthochirus* Karsch, 1891 from Somalia (Scorpiones: Buthidae)
Wilson R. Lourenço & Eric Ythier 335

***Gylippus* (*Paragylippus*) *arikani* sp. nov. (Solifugae: Gylippidae: Gylippinae) from Turkey with comparative remarks on the species of the subgenus *Gylippus* (*Paragylippus*) Roewer**
Halil Koç & Melek Erdek 350

A new distribution record for *Encyocratella olivacea* Strand, 1907 from Tanzania (Araneae: Theraphosidae)
Danniella Sherwood & Michele Menegon 360

On the biotopic distribution of spiders (Aranei) in the foothill of the southeastern slope of the Greater Caucasus
Nizami E. Novruzov 363

Faunal distribution of spiders of the families Titanoecidae, Trachelidae, Trochanteriidae, Uloboridae and Zodariidae (Arachnida: Araneae) in India
Garima Singh & Rajendra Singh 370

Orb-Web spiders (Arachnida: Araneae) of Maharashtra State, India
Pawan U. Gajbe 394

Spider fauna of some wetlands of Visnagar (Gujarat, India)
Bhavesh M. Parmar 400

Synonymization of *Pardosa mysorensis* (Tikader & Mukerji, 1971) with *Pardosa sumatrana* (Thorell, 1890)
Raveendran Sudha Abhijith, Palissery Sheeba & Ambalaparambil Vasu Sudhikumar 406

First record of male *Tropizodium viridurbium* Prajapati, Murthappa, Sankaran & Sebastian, 2016 from Melghat forest (Araneae: Zodariidae) India
Atul K. Bodkhe, Virendra P. Uniyal, Subhash S. Kamble, Shazia Quasin, Gajanan B. Santape, Mahesh P. Chikhale & Sawan M Deshmukh 413

An araneological study in Ali Mountain (Kayseri, Central Anatolia, Turkey)
Osman Seyyar, Emre Üstün & Hakan Demir 420

Notes on *Callilepis cretica* (Araneae: Gnaphosidae) and a new locality in Turkey
Osman Seyyar 425

Regional diversity of spiders in the selected sacred groves of northern Kerala, India
Njarekkattil Vasu Sumesh & Ambalaparambil Vasu Sudhikumar 429

Faunal diversity of Gnaphosidae (Arachnida: Araneae: Araneomorphae) in India: An updated Checklist
Rajendra Singh & Garima Singh 438

Redescription of *Rhagodinus caenaeicus* (Penther, 1913) (Solifugae: Rhagodidae) from Iraq
Azhar Mohammed AL-Khazali 474

***Micrommata formosa* in Jordan (Araneae: Sparassidae)**
Hisham K. El-Hennawy & Mohammad Al-Saraireh 481

Volume 17 (2019-2021)
Back issues: Vol. 1 (1987-1990), Vol. 2 (1990-1992), Vol. 3 (1992-1993), Vol. 4 (1994-1996), Vol. 5 (1996-1997), Vol. 6 (1998-2000), Vol. 7 (2000-2001), Vol. 8 (2002-2003), Vol. 9 (2004-2005), Vol. 10 (2006-2007), Vol. 11 (2008-2009), Vol. 12 (2010-2011), Vol. 13 (2012-2013), Vol. 14 (2014-2015), Vol. 15 (2016-2017), Vol. 16 (2018-2019).
Correspondence concerning subscription, back issues, publication, etc. should be addressed to the editor:
Hisham K. El-Hennawy
Postal address: **41, El-Manteqa El-Rabia St., Heliopolis, Cairo 11341, Egypt**
E-mail: el_hennawy@hotmail.com Webpage: http://serket1987.blogspot.com

****

ISSN: 1110-502X

Serket (2021) vol. 17(4): 325-334.

New considerations on the *Leiurus* Ehrenberg (Scorpiones: Buthidae) distributed in Africa and description of a particular species from Egypt

Wilson R. Lourenço [1] & Hisham K. El-Hennawy [2]

[1] Muséum national d'Histoire naturelle, Sorbonne Universités, Institut de Systématique, Evolution, Biodiversité (ISYEB), UMR7205-CNRS, MNHN, UPMC, EPHE, CP 53, 57 rue Cuvier, 75005 Paris, France. E-mail: wilson.lourenco@mnhn.fr

[2] 41 El-Manteqa El-Rabia St., Heliopolis, Cairo 11341, Egypt
E-mail: el_hennawy@hotmail.com

Abstract

One more new species is described for the genus *Leiurus* Ehrenberg from Africa. The description is based on one juvenile female collected in the region NE of Maghra, east of the Qattara Depression, Egypt. Although some affinities may be suggested with *L. quinquestriatus* and *L. hebraeus*, species distributed in Egypt and Israel, several characteristics attest however that this population is certainly distinct. The type locality of the new species corresponds to a very poorly prospected zone in Egypt and further studies in the area should provide new material confirming the present decision.

Keywords: Scorpion, systematics, *Leiurus*, Egypt, Africa.

Introduction

In recent years the number of new species of *Leiurus* described from Africa knew a remarkable improvement. This was possible due to new collecting but also to old specimens available in collections such as that of the Muséum in Paris. For more precise information, a recent synopsis is available in Lourenço (2020a). In many cases these more or less 'old' specimens were collected in regions which are no longer attainable in present days, mainly due to security reasons (Lourenço, 2020a,b). Since most historical aspects concerning the genus *Leiurus* were largely treated in a number of recent publications these will not be further discussed here (Lourenço, 2019, 2020a,b). At

present we focus exclusively on a peculiar specimen recently collected in Egypt. Until present it was assumed that only the classical species *Leiurus quinquestriatus* (Ehrenberg, 1828) was present in this country, although some questions remain about the true identity of the Sinai population (Sarhan *et al.*, 2020). The specimen presently studied was collected in a peculiar region of Egypt east of the Qattara Depression which may contain some patchy distributed populations (Saleh *et al.*, 2001). The comparative analysis of some characters associated to the trichobothrial pattern, but also the very high number of teeth on the pectines of this specimen, brings evidence for the description of a new species. Some aspects of the trichobothrial pattern seem also to plead for the existence of a distinct population in the Sinai.

Figs. 1-2. *Leiurus aegyptiacus* sp. n., female holotype. Habitus, dorsal and ventral aspects.

Methods

Illustrations and measurements were obtained using a Wild M5 stereo-microscope with a drawing tube and ocular micrometer. Measurements follow Stahnke (1970) and are given in mm. Trichobothrial notations follow Vachon (1974) and morphological terminology mostly follows Vachon (1952) and Hjelle (1990).

Taxonomic treatment

Family Buthidae C.L. Koch, 1837

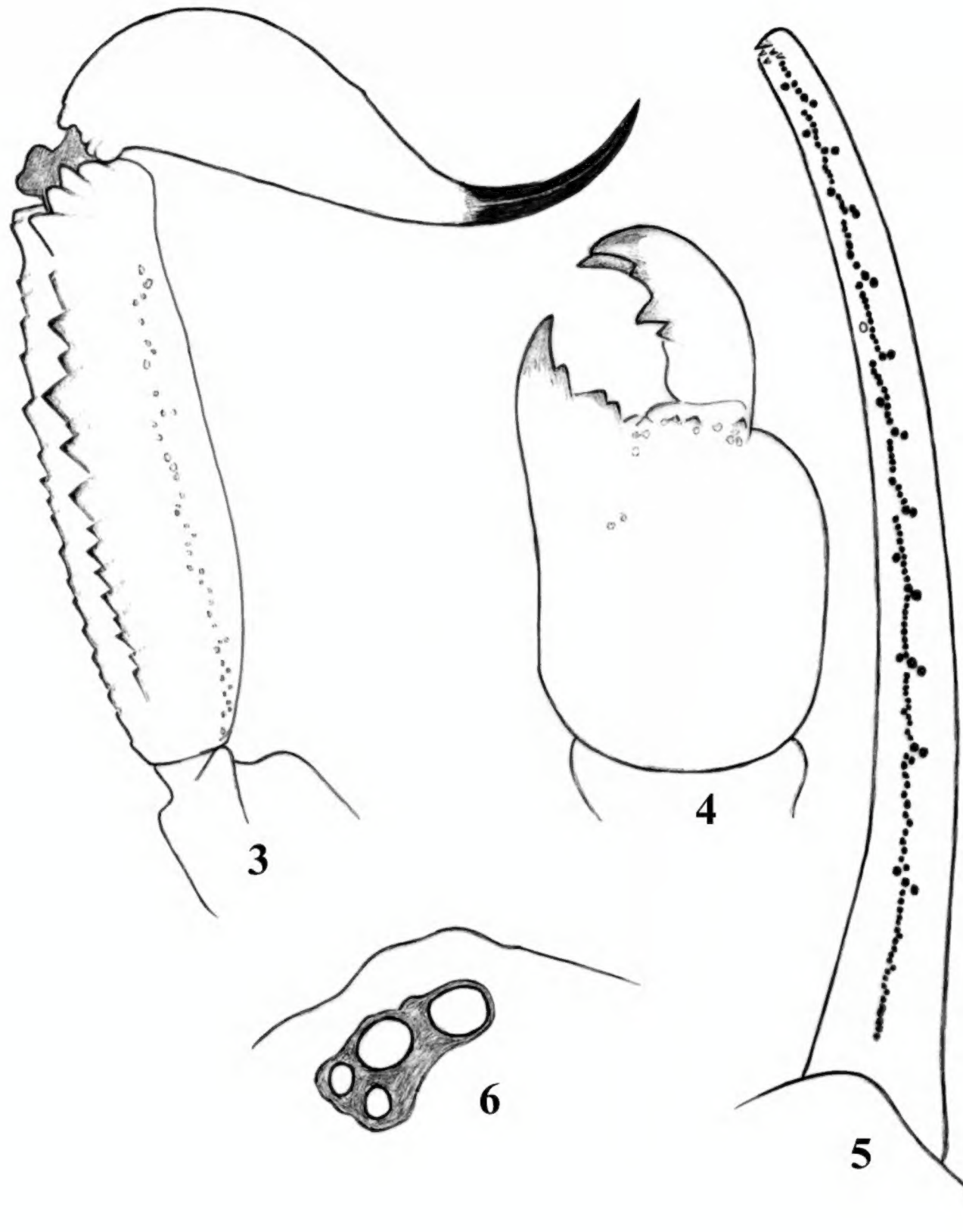
Genus *Leiurus* Ehrenberg, 1828

Leiurus aegyptiacus sp. n. (Figs. 1-11, 16)

Type material: Holotype, female juvenile. Egypt, NE of Maghra, East of the Qattara Depression, about 52 km SE of El Alamein, (30°23'3.84"N, 29°10'0.12"E) 130 m, 22/IV/2006 (P. Géniez). The holotype will be deposited in the Muséum national d'Histoire naturelle, Paris.

Etymology: specific name refers to Egypt the country where the new species was found.

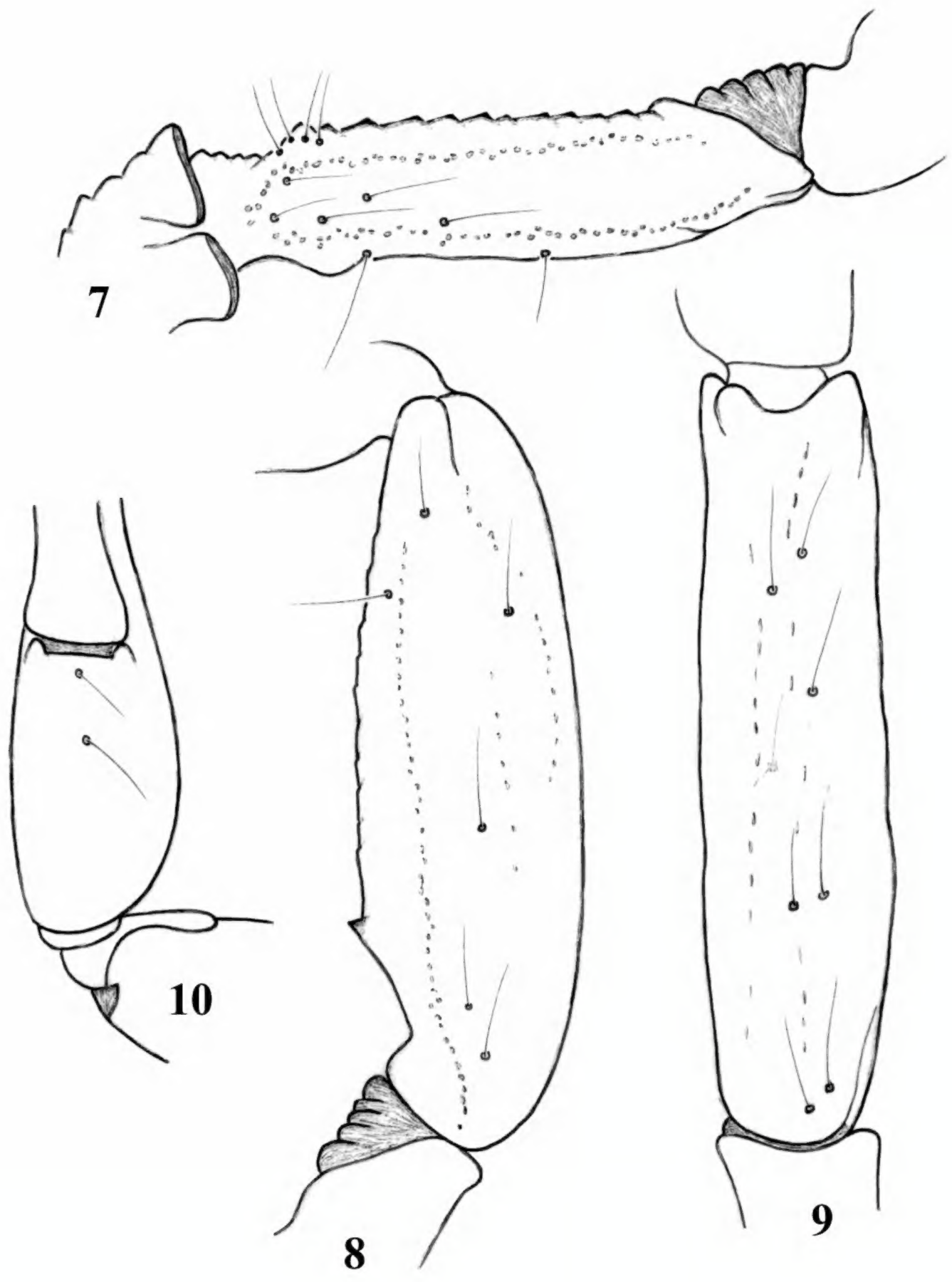
Diagnosis: The female juvenile has a total length of 26.5 mm. Based on the theoretical morphometric growth factor for arthropods defined by Dyar (1890) and Przibram & Megusar (1912), and in account of the average size of adult *Leiurus* species, it is possible to suggest that the described specimen is a second instar juvenile. This excluding the pro-juvenile instar and counting only juvenile instars from I to VI. Ground colour yellow to pale yellow for both the body and appendages; ventral aspect of metasomal segments and in special segment V strongly spotted. Carapace strongly spotted in its central zone forming an almost square spot. Ocular tubercle moderately prominent. Pectines with 40-40 teeth. Median carinae on sternite III moderately to weakly marked; on sternite IV vestigial; sternite VII with mediate intercarinal surface almost without granulations. Pedipalp fingers with 11-12 rows of granules. Telson with a long aculeus, slightly longer than vesicle, but weakly curved. Dorsal trichobothrium of femur, $\mathbf{d_4}$ in the same position of external trichobothrium $\mathbf{e_1}$, Trichobothria **db** and **est** of fixed finger almost at the same level.



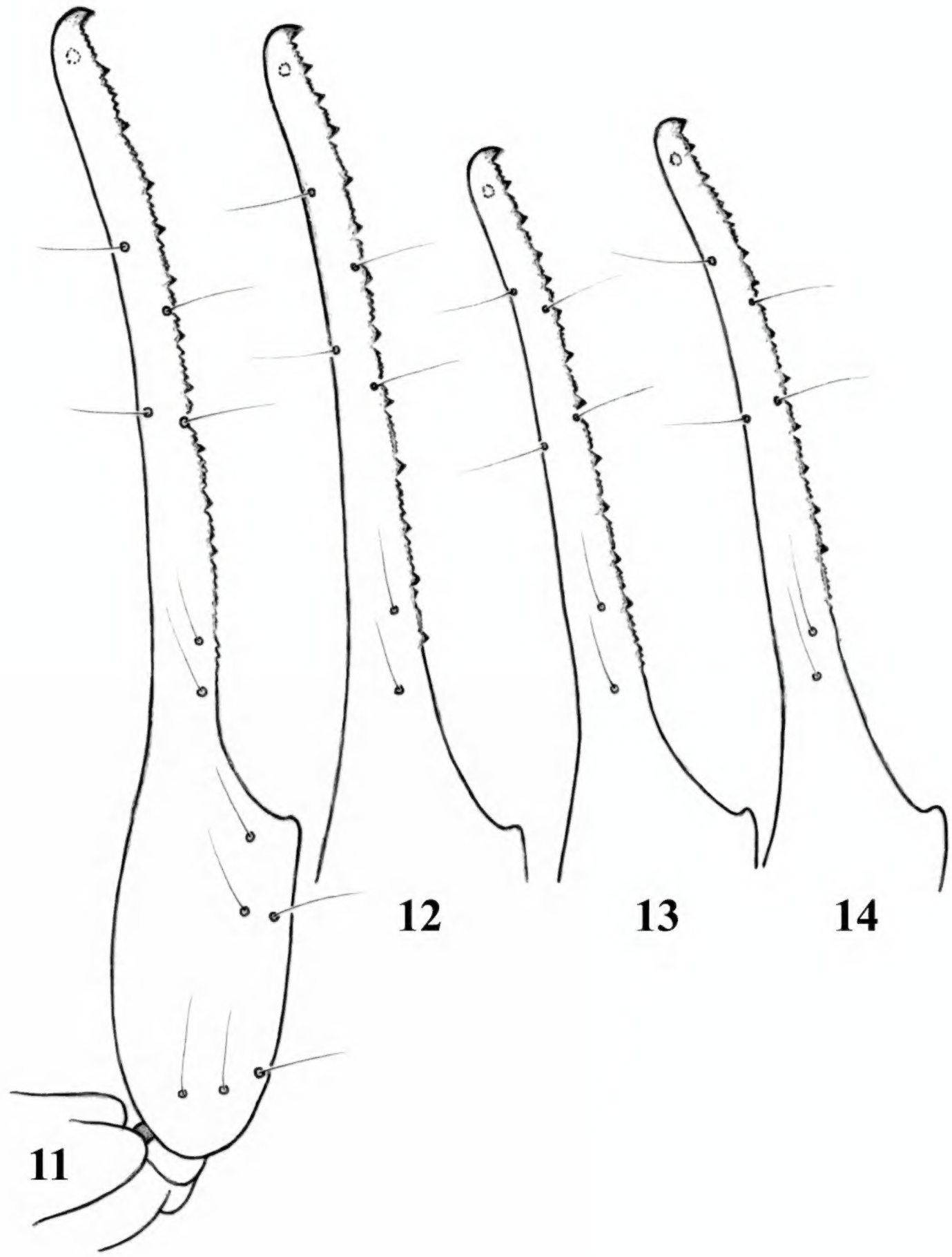
Figs. 3-6. *Leiurus aegyptiacus* sp. n., female holotype. 3. Metasomal segment V and telson, lateral aspect. 4. Chelicera, dorsal aspect. 5. Cutting edge of movable finger with rows of granules. 6. Left side of carapace with lateral eyes.

Description based on holotype. Morphometric values presented after the description.

Colouration. Ground colour yellow to pale yellow; pedipalps and legs totally pale yellow. Carapace pale yellow with an almost square spot in the central zone; eyes blackish. Mesosoma yellow with some weak infuscations on tergites I to VI. Metasomal segments I to IV pale yellow with some blackish spots ventrally; segment V intensely spotted with blackish. Vesicle pale yellow with the aculeus yellow at the base and red at its extremity. Venter yellow to pale yellow; coxapophysis slightly reddish. Chelicerae pale yellow without any reticulated spots; teeth red. Pedipalps yellow to pale yellow overall except for the rows of granules on chela fingers which are red. Legs pale yellow.



Figs. 7-10. *Leiurus aegyptiacus* sp. n., female holotype. Trichobothrial pattern. 7. Femur, dorsal aspect. 8-9. Patella, dorsal and external aspects. 10. Chela, ventral aspect.



Figs. 11-14. Comparative trichobothrial patterns of chela and fixed finger. 11. *Leiurus aegyptiacus* sp. n., female holotype. 12. *Leiurus quinquestriatus*, female from Central Egypt. 13. *Leiurus hebraeus*, female from Israel. 14. *Leiurus* sp., female from Sinai. It can be observed that the relative position of trichobothria **db** and **est** are distinct for each species.

Morphology. Prosoma: The anterior margin of carapace with a vestigial concavity. Carapace carinae moderately developed; central median and posterior median carinae moderate; anterior median carinae moderate to weak; central lateral obsolete; posterior median and posterior lateral carinae moderate to weak, terminating distally in a very small spinoid process that extends very slightly beyond the posterior margin of the carapace. Intercarinal spaces with very few irregular granules, and the reminder of the surface almost smooth, in particular laterally and anteriorly. Median ocular tubercle anterior to the centre of the carapace and moderately prominent; median eyes large in size and separated by about two ocular diameters; four/five lateral eyes observed; the third to

fifth largely reduced. Mesosomal tergites I-II pentacarinate; III-VI tricarinate. All carinae moderate to strong, terminating distally in a spinoid process that extends slightly beyond the posterior margin of the tergite. Median carinae on I moderate, on II-VI moderate to strong. Tergite VII pentacarinate, with lateral pairs of carinae moderate to strong and fused; median carinae present on the proximal half, moderate to strong. Intercarinal spaces very weakly granular. Lateral carinae very weak on sternite III; weak on sternites IV-VI; moderate on VII; median carinae on sternites III-IV weak to absent. Pectines long; pectinal tooth count 40-40. Metasomal segments I-III with ten carinae, moderately crenulate; lateral inframedian carinae on I complete; on II and III represented on the posterior zone by a few granules; IV with eight carinae. Dorsal and dorsolateral carinae moderate, without any enlarged denticles distally. All the other carinae moderate to weak on segments I-IV. Segment V with five carinae; ventromedian carinae with several spinoid granules distally; anal arch with three slightly spinoid lobes. Dorsal furrows of all segments weakly developed and smooth; intercarinal spaces almost smooth, with only a few granules on the ventral surface of segment V. Telson almost smooth; subaculear tubercle absent; aculeus slightly longer than vesicle. Chelicerae with one denticle at the base of the movable finger, possible resulting of the fusion of the two denticles (Vachon, 1963). Pedipalps: Trichobothrial pattern orthobothriotaxic, type A (Vachon, 1974); dorsal trichobothria of femur in β (beta) configuration (Vachon, 1975). Dorsal trichobothrium of femur $\mathbf{d_4}$ in the same position of external trichobothrium $\mathbf{e_1}$, Trichobothria **db** and **est** of fixed finger almost at the same level. Femur pentacarinate; all carinae moderately crenulate. Patella with seven carinae; all carinae moderately to weakly crenulate; dorsointernal carinae with 3-4 small spinoid granules. Chelae slender, with elongated fingers, smooth and without carinae. Dentate margins of fixed and movable fingers composed of 11-12 almost linear rows of granules. Legs: Ventral aspect of tarsi with short spiniform setae more or less arranged in two rows. Tibial spurs present on legs III and IV, moderately marked. Pedal spurs present on all legs, strongly marked.

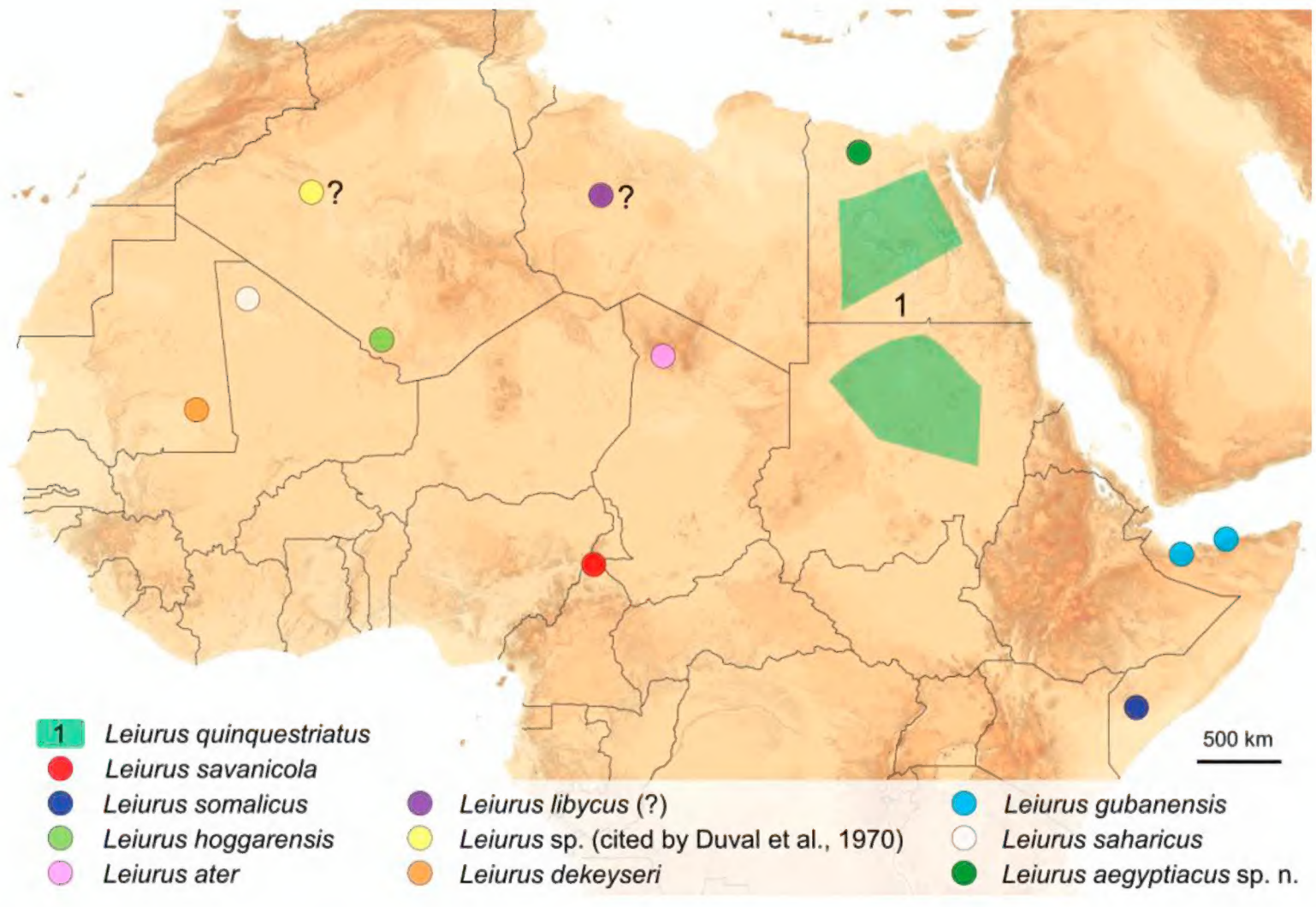


Fig. 15. Map of the North portion of Africa showing the distribution of the known *Leiurus* species.

Relationships. It is possible to suggest that the new species shows some affinities with *Leiurus quinquestriatus* and *Leiurus hebraeus* respectively distributed in Egypt and Israel. It differs nevertheless by a number of characters: (i) an extremely high number of teeth on the pectines, 40-40, not observed for females of other species, (ii) median carinae on sternite III weak to absent, (iii) 11-12 rows of granules on pedipalps fingers, (iv) a particular position of fixed finger trichobothria **db** and **est** which are almost in the same level; see Figs. (11-14) for further explanations. Moreover, the geographic zone of distribution of the new species has been poorly prospected until now. The description of the new species based on a juvenile specimen is not ideal, but the future examination of new material from the type locality should confirm the present decision.

Morphometric values of the female-juvenile holotype of *Leiurus aegyptiacus* sp. n.
Total length including the telson, 26.5. Carapace: length 2.8; anterior width 2.0; posterior width 3.2. Mesosoma length: 8.2. Metasomal segments. I: length 2.0, width 1.2; II: length 2.2, width 1.1; III: length 2.3, width 1.1; IV: length 2.6, width 1.0; V: length, 3.3, width 1.0, depth 0.9. Telson length 3.1; vesicle: width 0.8, depth 0.8. Pedipalp: femur length 2.9, width 0.8; patella length 3.6, width 1.0; chela length 5.6, width 0.8, depth 0.8. Movable finger length 4.0.

Distribution of the genus *Leiurus* in Africa

As already outlined in previous publications (Lourenço, 2020a,b), the most recent discoveries and descriptions related to *Leiurus* in Africa led to the confirmation of the known species for the following countries in Africa: Algeria, Cameroon, Chad, Egypt, Libya, Mali, Mauritania, Niger, Somalia, Somaliland, and Sudan. Occurrences for some other countries require yet a precise confirmation as for Ethiopia and Tunisia. The major population in Africa clearly corresponds to *Leiurus quinquestriatus* in Egypt and Sudan with the other species located in more patchy distributions (Fig. 15 map). The description of a second species from Egypt seems to confirm this patchy model since the new species is apparently endemic to a very particular ecological habitat in Egypt represented by the region NE of Maghra, east of the Qattara Depression.

Fig. 16. *Leiurus aegyptiacus* sp. n., female holotype, alive. © Philippe Geniez.

Fig. 17. Habitat of *Leiurus aegyptiacus* sp. n. © Philippe Geniez.

Ecological description of the collecting locality

The studied specimen (Fig. 16) was collected in a locality (Fig. 17) known as Tallet El-Tibn, about 50 km south of the Mediterranean coast and 25 km northeast of Lake Maghra just outside the eastern edge of the Qattara Depression (Fig. 18). The area is about 130 m above sea level, but dips gradually towards El Maghra Oasis (-38 m) with which, it seems to be ecologically continuous. Sand deposits in the form of small, fused dunes and deep sheets cover the area (Zahran & Willis, 1992).

Fig. 18. Map of the Northern part of Egypt showing the Qattara Depression (1), Maghra (2) and collecting locality of *Leiurus aegyptiacus* sp. n. (red circle).

The area is climatically hyper-arid (Ayyad & Ghabour, 1986) with a winter precipitation averaging less than 50 mm per year. It is covered with a sparse vegetation cover (about 5%) of a community dominated by *Zygophyllum album* [now *Tetraena alba*] which characterizes the relatively higher sandy area at the fringes of the Maghra Depression. Associates include *Alhagi graecorum*, *Artemisia monosperma*, *Nitraria retusa*, *Sporobolus spicatus*, and *Tamarix nilotica* (Girgis *et al.*, 1971; Zahran & Willis, 1992). As the ground dips deeper into the Maghra Depression to the southwest, *Nitraria retusa* and *Tamarix nilotica* become more dominant in the saline sandy soil, growing in extensive patches and building large phytogenic sand mounds (Fig. 19). In the yet deeper part of the Maghra Depression, saline flats between the hypersaline Lake Maghra and the sand formations are densely vegetated with a halophytic community dominated by *Juncus rigidus* with associates including *Arthrocnemum macrostachyum*, *Cressa cretica*, *Limbarda crithmoides*, *Nitraria retusa*, *Phragmites australis*, and *Tamarix nilotica* (Girgis *et al.*, 1971; Zahran & Willis, 1992) (Saleh *in litt.*).

Fig. 19. Typical habitat NE of Maghra. © Mostafa Saleh.

Acknowledgments

We are most grateful to Elise-Anne Leguin (MNHN) for preparing the photos of the habitus of the new species and to Lucienne Wilmé (Missouri Botanical Garden, USA) for the preparation of the map (Fig. 15). We are greatly indebted to Philippe Geniez (Paris) for the photos of the new species "*in vivo*" and its habitat and to Mostafa Saleh (Cairo) for the photo of the typical habitat NE of Maghra and for his ecological description of the collecting locality.

References

Ayyad, M.A. & Ghabour, S.I. 1986. Hot deserts of Egypt and the Sudan. Chapter 5. In: *Ecosystems of the World 12B, Hot Deserts and Arid Shrublands* (eds. Evenari, M. Noy-Meir, I. and D. Goodall). Elsevier, Amsterdam, pp. 149-202.

Dyar, H.G. 1890. The number of molts of lepidopterous larvae. *Psyche*, 5: 420-422.

Girgis, W.A., Zahran, M.A., Reda, K.A. & Shams, H. 1971. Ecological notes on Moghra Oasis (Western Desert, Egypt). *Egypt. J. Bot.*, 14: 145-155.

Hjelle, J.T. 1990. Anatomy and morphology. Pp. 9-63. In: G.A. Polis (ed.), *The Biology of Scorpions*. Stanford University Press, 587 pp.

Lourenço, W.R. 2019. Nouvelles considérations sur les *Leiurus* Ehrenberg, 1828 collectés dans la région du Tibesti, Tchad et description d'une nouvelle espèce (Scorpiones: Buthidae). *Revista Ibérica de Aracnología*, 34: 133-137.

Lourenço, W.R. 2020a. A remarkable new species of *Leiurus* Ehrenberg, 1828 from the North Deserts of Mali (Scorpiones: Buthidae). *Revista Ibérica de Aracnología*, 37: 147-152.

Lourenço, W.R. 2020b. Why does the numbers of dangerous species of scorpions increase? The particular case of the genus *Leiurus* Ehrenberg (Buthidae) in Africa. *Journal of Venomous Animals and Toxins including Tropical Diseases*, 26: 1-9.

Przibram, H. & Megusâr, F. 1912. Wachstummessungen an *Sphodromantis bioculata* Burm. I, Lange und Masse. *Archiv für Entwicklungsmechanik der Organismen* (Wilhelm Roux), 34: 680-741.

Saleh, M.A., Helmy, I. & Giegengack, R. 2001. The Cheetah, *Acinonyx jubatus* (Schreber, 1776) in Egypt (Felidae, Acinonychinae). *Mammalia*, 65(2); 177-194.

Sarhan, M., Badry, A., Younes, M. & Saleh, M. 2020. Genetic diversity within *Leiurus quinquestriatus* (Scorpiones: Buthidae) populations in Egypt as inferred from 16S mDNA sequence analysis. *Zoology in the Middle East*, 66(3): 269-276.

Stahnke, H.L. 1970. Scorpion nomenclature and mensuration. *Entomological News*, 81(12): 297-316.

Vachon, M. 1952. *Etudes sur les scorpions*. Publications de l'Institut Pasteur d'Algérie, Alger: 482 pp.

Vachon, M. 1963. De l'utilité, en systématique, d'une nomenclature des dents des chélicères chez les Scorpions. *Bulletin du Muséum national d'Histoire naturelle*, Paris, 2e sér., 35(2): 161-166.

Vachon, M. 1974. Etude des caractères utilisés pour classer les familles et les genres de Scorpions (Arachnides). 1. La trichobothriotaxie en arachnologie. Sigles trichobothriaux et types de trichobothriotaxie chez les Scorpions. *Bulletin du Muséum national d'Histoire naturelle*, Paris, 3e sér., n° 140, Zool. 104: 857-958.

Vachon, M. 1975. Sur l'utilisation de la trichobothriotaxie du bras des pédipalpes des Scorpions (Arachnides) dans le classement des genres de la famille des Buthidae Simon. *Comptes Rendus des Séances de l'Académie de Sciences*, 281(D): 1597-1599.

Zahran, M.A. & Willis, A.J. 1992. The vegetation of Egypt. Chapman and Hall Pub. London, VI, pp. 424.

Leiurus aegyptiacus **Lourenço & El-Hennawy, 2021**
urn:lsid:zoobank.org:act:4B78C63D-823E-4961-BA36-6432D7BF7DCE

Serket (2021) vol. 17(4): 335-349.

A particular new species of *Orthochirus* Karsch, 1891 from Somalia (Scorpiones: Buthidae)

Wilson R. Lourenço [1] & Eric Ythier [2]

[1] Muséum national d'Histoire naturelle, Sorbonne Universités, Institut de Systématique, Evolution, Biodiversité (ISYEB), UMR7205-CNRS, MNHN, UPMC, EPHE, CP 53, 57 rue Cuvier, 75005 Paris, France. E-mail: wilson.lourenco@mnhn.fr

[2] BYG Conservation, 382 rue des Guillates, 71570 Romanèche-Thorins, France
E-mail: eric.ythier@gmail.com

Abstract

A new species of buthid scorpion, *Orthochirus arenicola* sp. n. is described from the coasts of Somalia. The scorpion was collected on the beach sand under bush-like herbaceous vegetation by our late Italian colleague Professor P. M. Brignoli.

New considerations are also proposed for other related taxa. *Orthochirus afar* Kovařík & Lowe, 2016 described from Afar, Ethiopia is suggested to be a synonym of *Orthochirus aristidis* (Simon, 1882); no final decision is taken however face to the impossibility of consulting the types of *Orthochirus afar*. *Orthochirus aristidis* is restored from its synonymy with *Orthochirus olivaceus* (Karsch, 1881). Finally, the genus *Orthochiroides* Kovařík, 1998 is placed as a junior synonym of *Orthochirus* Karsch, 1891.

Keywords: Scorpion, *Orthochirus*, *Orthochiroides*, new species, beach sand, Somalia.

Introduction

In several previous publications (Lourenço & Leguin, 2011a,b; Lourenço *et al.*, 2012), the status of the African species belonging to the genus *Orthochirus* Karsch, 1891 was reconsidered and the identities of the two classical species *Orthochirus aristidis* (Simon, 1882) and *Orthochirus innesi* Simon, 1910 were clarified. This revision also conducted to the description of four new species from the Western portion of North Africa, namely from Algeria, Morocco, and Mauritania. Subsequently, two other species

were described from the massifs of Chad (Lourenço *et al.*, 2012) and more recently, one more new species was also described from Algeria (Lourenço & Sadine, 2021-in press).

Since most historical aspect concerning the genus *Orthochirus* were already treated in previous publications (Lourenço & Leguin, 2011a), they will not be further discussed here. However, since in the present note we focus on a particular specimen of *Orthochirus* collected in Somalia by our late colleague Professor P. M. Brignoli, this leads us to reconsider the taxonomic position of some *Orthochirus* species recently described or revised from this part of Africa, in particular the status of *Orthochirus aristidis* (Simon, 1882) placed in synonymy of *Orthochirus olivaceus* (Karsch, 1881) by Kovařík *et al.* (2020a), but without a clear and precise justification. Moreover, since Kovařík *et al.* (2016) suggested that no *Orthochirus* species could be expected to be found in Somalia, and that all the local populations should rather be associated to the genus *Orthochiroides* Kovařík, 1998, we decide to analyse the validity of this last genus. Our conclusions suggest that *Orthochiroides* is based only on minor differences with *Orthochirus* which do not justify the generic status and therefore can be considered as a junior synonym of this last genus.

Methods

Illustrations and measurements of scorpions were made with the aid of a Wild M5 stereo-microscope with a drawing tube (camera lucida) and an ocular micrometer. Map and photos were made using Google Earth and Adobe Photoshop software. Measurements follow Stahnke (1970) and are given in mm. Trichobothrial notations are those of Vachon (1974) and morphological terminology mostly follows Vachon (1952) and Hjelle (1990).

Taxonomic treatment

Family Buthidae C.L. Koch, 1837

Genus *Orthochirus* Karsch, 1891

Part 1. General taxonomic remarks on the decisions taken by Kovařík *et al.* (2016) and Kovařík *et al.* (2020a) on the status of some Eastern African species of *Orthochirus*.

In one further paper dedicated to the study of scorpions of the Horn of Africa, Kovařík *et al.* (2016) described, among several others, one new species *Orthochirus afar* Kovařík & Lowe, 2016 from Afar, Ethiopia. In their diagnosis and analysis of relationships they associated the new species to *Orthochirus aristidis* (Simon, 1882), but have not consulted the type material of this species, one female lectotype and 3 males and 3 females paralectotypes, as defined by Lourenço & Leguin (2011a). Nevertheless, they strongly compared the characters of the new species, *O. afar* to those presented by Lourenço & Leguin (2011a) for the type material of *O. aristidis* and in particular to a female topotype collected in Wadi Halfa, Sudan (Nubia) in 1975 by P. M. Brignoli. They equally suggested doubts about the specimen of *O. aristidis* from Djibouti, presented in figure 5 by Lourenço & Leguin (2011a) and suggested that the material from Djibouti most certainly corresponded to a distinct species.

In account of the characters presented in the diagnosis of the species *O. afar*, we can reach the following conclusions: (i) *Orthochirus afar* is most certainly a synonym of *Orthochirus aristidis*; however, no final decision can be taken in face of the impossibility of examination of the type material of *O. afar*. Any revision of this type material is totally hampered by the fact that it is deposited in the private collection of one of the authors, therefore not accessible to Academic scientists in general. We do not agree with the

procedure used by these already cited authors who systematically place many species in synonymy without any consultation of the types or material from the type locality, hence we do not take a final decision regarding synonymy of *O. afar* with *O. aristidis*. (ii) Specimens of *O. aristidis* from Djibouti are available and they confirm that the zone of distribution of this species is certainly more important than expected.

In a subsequent publication, Kovařík *et al.* (2020a) took a different decision concerning the status of *Orthochirus aristidis* (Simon, 1882) which was placed in the synonymy of *Orthochirus olivaceus* (Karsch, 1881). It is most interesting to compare the procedures used in two publications, *i.e.* Kovařík *et al.* (2016) and Kovařík *et al.* (2020a). For both publications, the type material of *O. aristidis* was simply ignored; however, if in the 2016 publication the data of the topotype of *O. aristidis* from Wadi Halfa (Lourenço & Leguin, 2011a) was largely used comparatively for the description of *O. afar*, this same specimen was totally ignored in the 2020 paper. In their synonymy of *O. aristidis* with *O. olivaceus*, these authors argue as follows: '*The holotype label [...] says "Sicilia". This is clearly an incorrect locality as there are no Orthochirus species found in Sicily - or anywhere in Europe.*' Nothing brings final evidence to this suggestion since Sicily does have habitats which could be in adequation with *Orthochirus* species' biology. The original population could have vanished since the 19th century, as it happened for other populations (Lourenço & Rossi, 2013). They also insist that in account of the travelling done by the collector Gustav Schneider (1834-1900), a famous taxidermist and merchant from Basel, Switzerland, the type of *O. olivaceus* was most certainly collected in Egypt since other scorpions labelled as collected by G. Schneider have Egypt as locality. We can accept this proposition as possible; however, the comparative procedure done by Kovařík *et al.* (2020a) is ambiguous and shows contradictions with the analysis previously done by Kovařík *et al.* (2016). For their comparative analysis between *O. olivaceus* and *O. aristidis*, Kovařík *et al.* (2020a) examined the type specimen of *O. olivaceus*, a specimen poorly preserved and with a pale colouration most certainly associated with its age and faded condition. They compared this type specimen with one topotype female from Wadi Halfa (Nubia, Sudan), a specimen collected in 1983 and also with a rather pale colouration (their figures 11-12). A second partially pale specimen, a male collected in 2019 in Wadi El-Ga'ab (Northern State, Sudan) is also used in their comparative analysis (their figures 13-14). It is remarkable to notice that the topotype presented by Lourenço & Leguin (2011a) and extensively cited by Kovařík *et al.* (2016) is totally ignored in this new study of Kovařík *et al.* (2020a). Most important, the topotype illustrated by Lourenço & Leguin (2011a) was collected in 1975, but is well preserved and presents the typical very dark to blackish colouration of all the known specimens of *O. aristidis* from Egypt, Sudan, and Djibouti (see Figs. 1-2). In face to these most certain contradictions, it seems obvious that the synonymy proposed by Kovařík *et al.* (2020a) is incorrect and that the two species *O. olivaceus* and *O. aristidis* are distinct. Therefore, we restore here the validity of *O. aristidis*. How to explain, however, the marked differences observed between the two 'topotype' specimens proposed by Lourenço & Leguin (2011a) and Kovařík *et al.* (2020a)? The only possible explanation is that these belong to distinct species (*O. olivaceus* and *O. aristidis*), both present in a common zone of distribution in the arid zones of Sudan and Egypt.

Part 2. The validity of the genus *Orthochiroides* Kovařík, 1998 (Figs. 16-20).
Orthochiroides Kovařík, 1998: 115; Fet & Lowe, 2000: 192.
Material examined: 1 male paratype of *Orthochiroides vachoni* Kovařík, 1998, deposited in the Muséum national d'Histoire naturelle, Paris.

Figs. 1-2. *Orthochirus aristidis*, female topotype from Nubia, Sudan. 1. Dorsal aspect. 2. Ventral aspect (from Lourenço & Leguin, 2011a).

As already stated in the introduction, since Kovařík *et al*. (2016) suggested that no *Orthochirus* species could be expected to be found in Somalia, and that all the local populations should rather be associated to the genus *Orthochiroides* Kovařík, 1998, we decide to analyse the validity of this last genus. This was only possible because following

the description of this new genus, based on the type species of *Orthochiroides vachoni* Kovařík, 1998, at least one paratype of this last species was sent to the collections of the Muséum national d'Histoire naturelle, Paris. All the original type series of *O. vachoni* originally belonged to the Museo Zoologico de "La Specola", Firenze in Italy and one can wonder who or what authorised Kovařík (1998) to distribute paratypes to several museums in Europe (even if he kept a majority to his personal collection). But this is another matter.

Historically this material is one example among others of specimens previously studied and pre-determined by M. Vachon over several decades. Starting on the 1990s Kovařík noticed these pre-determined specimens by Vachon and started to track and describe a maximum of new genera and species. If so many specimens pre-determined by Vachon remained unpublished, this is due to the enormous hesitation showed by Vachon during his career. In fact, Vachon was extremely afraid of doing mistakes, and many of his taxonomic decisions were never concretised.

Now back to the taxonomic status of the genus *Orthochiroides*, the original diagnosis of the genus proposed by Kovařík (1998) is rather confuse and can be summarized as follows: '*The basic trichobothrial pattern is beta [...]; the third and fourth legs have well developed tibial spurs; pectines bear fulcra [...]; the dentate margin of pedipalps-chela movable finger has granules distinct, divided into rows, and spanning the length of the finger [...]; in lateral view, the carapace is inclined downward from the median eyes to the anterior margin [...]. Orthochiroides gen. n. is also characterized by the number and distribution of trichobothria on the pedipalps [...], seven to nine cutting edges on the movable fingers of pedipalps [...], presence of four pairs of lateral eyes, shape of the telson [...], mesosoma with one dorsal and four ventral keels, six pronounced keels on the tibia of pedipalps [...], dense granulation of nearly the entire body, and other features included in the description of Orthochiroides vachoni sp. n. [...]*'.

In a subsequent diagnosis the genus is presented as follows: '*Patella of pedipalp without ventral trichobothria. Dorsal trichobothria of femur arranged in beta-configuration. Trichobothrium d_2 of pedipalp femur absent on dorsal surface. Pectines with fulcra. Tibial spurs present on third and fourth legs. Tarsomere I of first to third legs with bristlecombs in females, often without bristlecombs in males. Movable fingers of pedipalps bear 7-9 rows of granules. Carapace, in lateral view, slopes distinctly downward from median eyes to anterior margin. First and second metasomal segments with carinae. Fourth and fifth metasomal segments of adults ventrally punctate. Telson bulbous, aculeus shorter than vesicle. Total length under 40 mm*'.

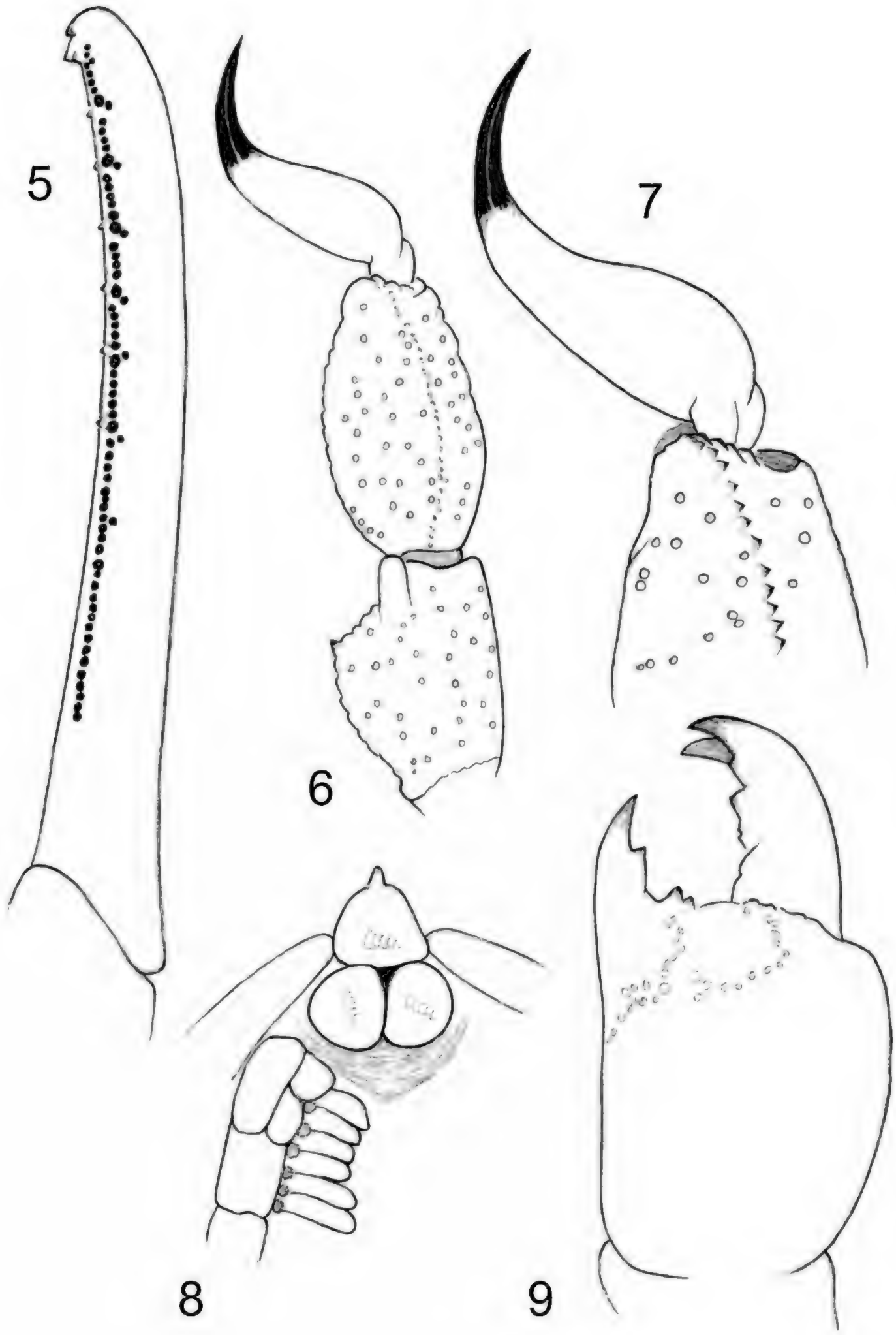
It clearly appears that the totality of the diagnostic characters proposed to define *Orthochiroides* is a sum of general characters without any generic value. Only two of these characters call the attention: the presence of four pairs of lateral eyes and the very bulbous telson. The first character, number of lateral eyes, did not match for the paratype we studied which presents only three pairs. As for the bulbous telson, indeed this character is present in *O. vachoni*, however it seems not sufficient for the definition of a new genus. Quite many other genera have strong variations in the shape of the telson. Consequently, we conclude that the genus *Orthochiroides* is based only on minor differences with *Orthochirus* which do not justify its generic status and therefore can be considered as a junior synonym of this last genus. So the new synonymy is proposed, *Orthochiroides* Kovařík, 1998 is a junior synonym of *Orthochirus* Karsch, 1891.

A paradox is regularly observed in the decisions of these same authors, frequently 'destroying' many distinct genera created by other authors which are based on much more solid morphological arguments (*e.g.* Kovařík *et al.*, 2020b).

Figs. 3-4. *Orthochirus arenicola* n. sp., male holotype. 3. Dorsal aspect. 4. Ventral aspect.

Part 3. Description of a new species.
Orthochirus arenicola sp. n. (Figs. 3-15, 21, 23-24)

Holotype male. Somalia, Lidaan (also known as Hilalaye) beach, XI/1975 (P. M. Brignoli). Collected in the beach sand under bush-like herbaceous vegetation. The type specimen is a pre-adult, most certainly a third instar juvenile (see measurements and note after the description). The holotype will be deposited in the Muséum national d'Histoire naturelle, Paris.



Figs. 5-9. *Orthochirus arenicola* n. sp., male holotype. 5. Cutting edge of movable finger with rows of granules. 6. Metasomal segment IV-V and telson, lateral aspect. 7. Telson, lateral aspect. 8. Sternum and genital operculum. 9. Chelicera, dorsal aspect.

Etymology. The specific epithet is an adjective derived from the Latin word for living in the sand. It refers to the habitat of the new species (sand beach).

Diagnosis. Adult specimens are probably small to moderate in size compared to other known species of the genus, reaching a total length of 21 to 25 mm for males. The third instar male juvenile described has a total length of 14.55 mm. General colouration brownish-yellow. Anterior margin of carapace straight. Ventral aspect of metasomal segment V without any granulations posteriorly. Fixed and movable fingers of pedipalps

with 8-9 rows of granules; accessory granules present next to the six distal rows. Pectines with 17-17 teeth in male. Trichobothriotaxy: A-β (Beta) neobothriotaxy 'minorante'; trichobothrium $\mathbf{d_2}$ and one internal trichobothrium are absent on femur. The absence of trichobothrium $\mathbf{i_2}$ of femur was observed in species of several buthid genera, but exclusively for the second instar juveniles (Stewien & Delgado, 1968; Vachon, 1974; Lourenço, 1980). This character was observed by Vachon (1974) for several buthid genera but not for *Orthochirus*. However, not enough elements are available to suggest a particular ontogenetic variation in *Orthochirus* species. Based on the morphometric growth factor defined for arthropods (see measurements section), the studied specimen reached at least the third or even fourth juvenile instar. Finally, no reaction to UV light was observed for the studied specimen (see Figs. 21-22), a phenomenon already observed for other buthid such as for *Leiurus saharicus* Lourenço, 2020, recently described from Mali (Lourenço, 2020). Although the specimen is juvenile, the cuticular sclerotization is totally finished since the previous moult.

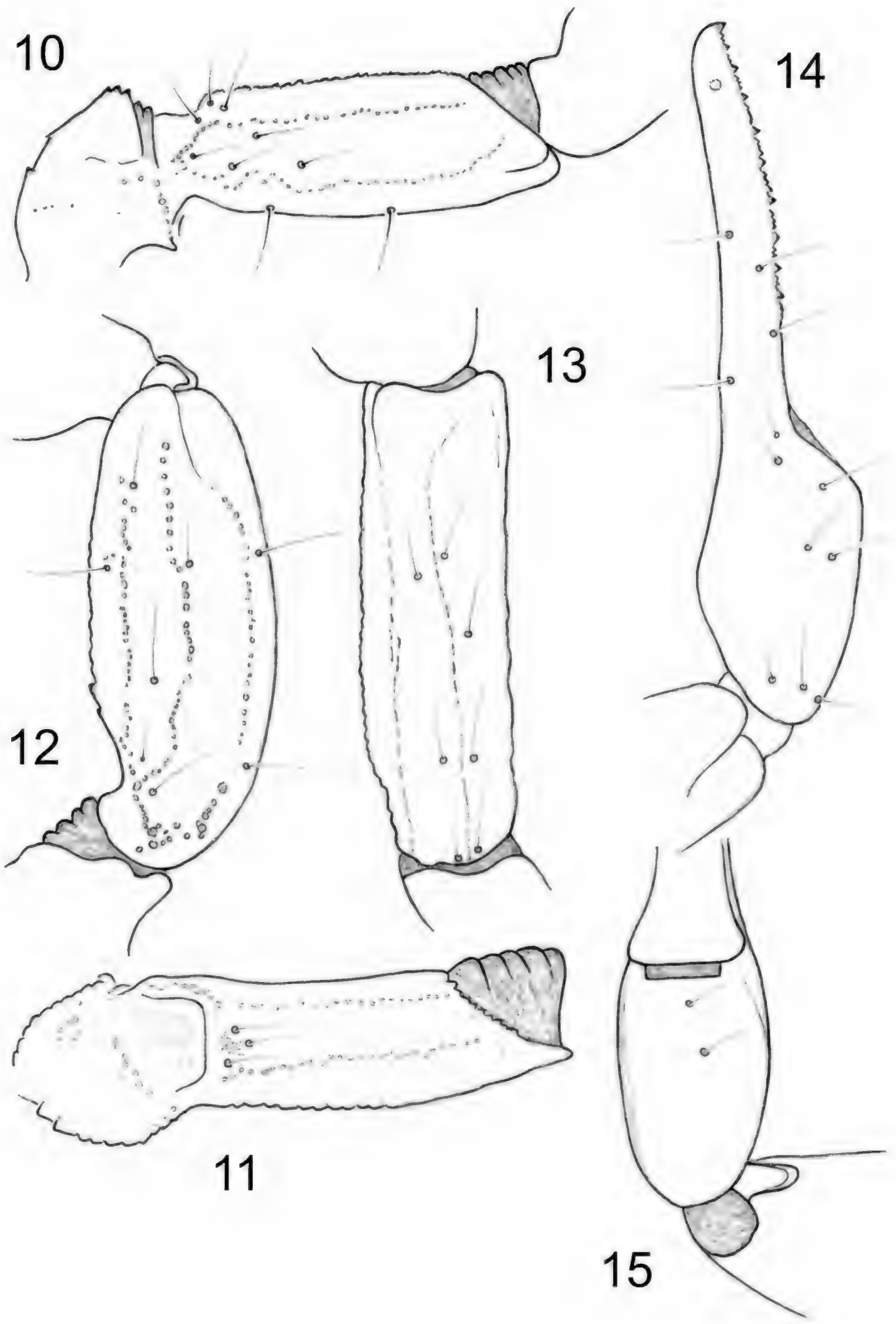
Relationships. *Orthochirus arenicola* sp. n. can be distinguished from the other African species of *Orthochirus*, and in particular from *Orthochirus aristidis* Simon, which presents the most close geographic distribution, by the following main features: (i) a smaller size in adults, (ii) a distinct and paler pigmentation pattern, even supposing that the adults may be darker, (iii) carapace and tergites less granulated, (iv) a distinct trichobothrial pattern with the absences of $\mathbf{d_2}$ and one internal trichobothrium on femur; possibly $\mathbf{i_1}$.

Description based on male holotype.

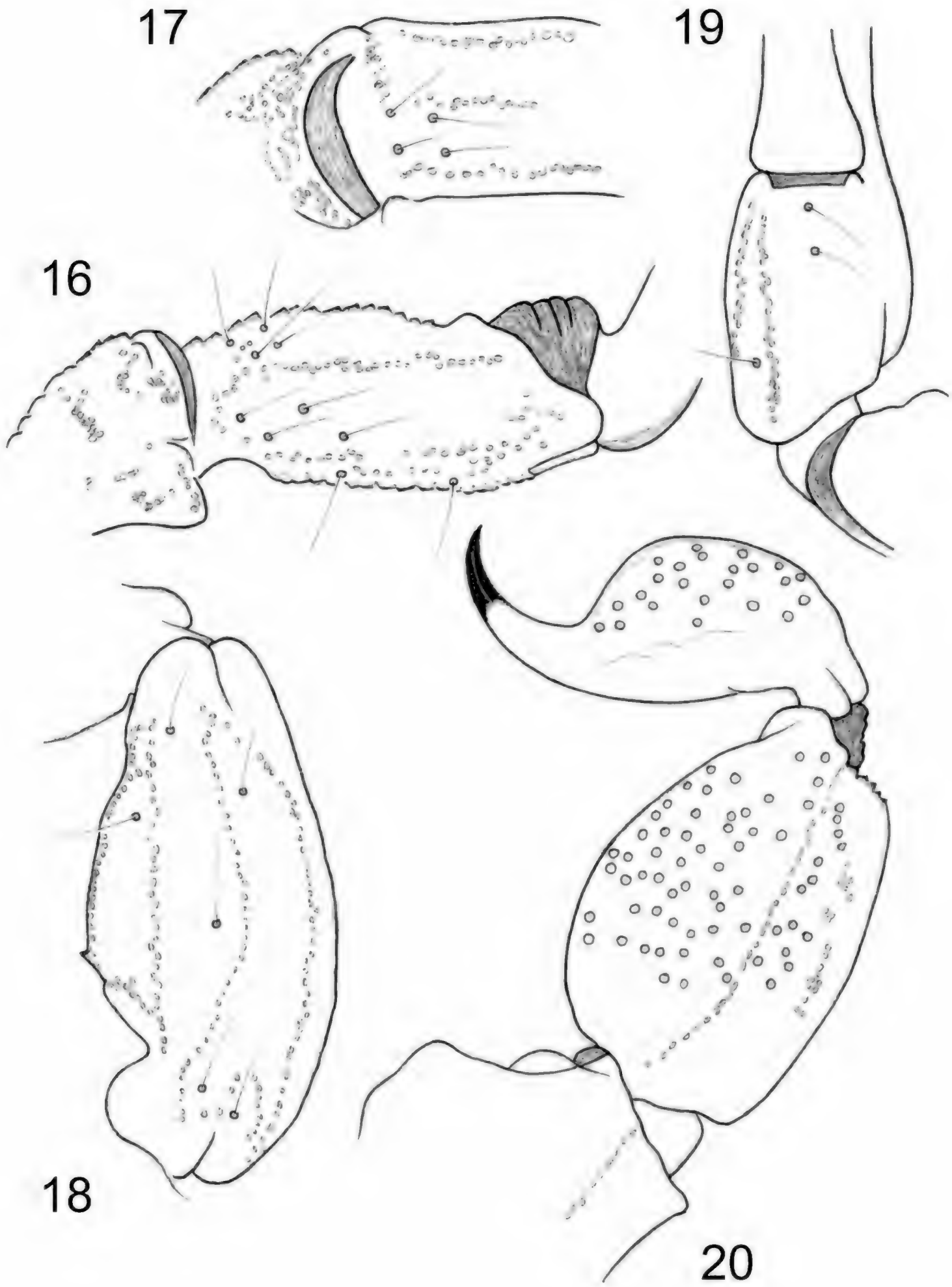
Colouration: Basically brownish-yellow with some darker zones on femur and patella of pedipalps. Prosoma: carapace pale brown-yellow with paler zones posteriorly; median and lateral eyes surrounded by black pigment. Mesosoma: pale brown; carinae and granulations slightly darker. Metasomal segments reddish-yellow to reddish-brown with darker zones over the carinae; telson reddish-yellow; aculeus yellowish at the base and reddish at the tip. Venter yellow to reddish-yellow; genital operculum and pectines pale yellow. Chelicerae brownish-yellow, with dark variegated spots covering the entire surface; fingers dark red with yellow teeth. Pedipalp femur and patella brownish; chela brownish-yellow with pale yellow fingers; oblique rows of granules on fingers pale-red. Legs pale brown.

Morphology: Carapace with a thin granulation on anterior and posterior zones; central zone around ocular tubercle almost smooth; anterior margin totally straight. Carinae and furrows weakly marked. Median ocular tubercle anterior to the centre of the carapace; median eyes separated by more than one ocular diameter. Three pairs of lateral eyes. Sternum subtriangular to subpentagonal, longer than wide. Mesosoma: tergites with thin granulation; median carina weak to vestigial in all tergites. Tergite VII pentacarinate with strong carinae. Venter: genital operculum small, not elongated, divided longitudinally into two sub-oval plates. Pectines: pectinal tooth count 17-17 in male holotype; basal middle lamellae of each pecten not dilated. Sternites almost smooth, slightly chagrined, with small slit-like spiracles; VII with two carinae weakly marked. Metasomal segments rounded, with carinae moderately marked; granulations weakly marked, almost smooth; segments I-II with ten carinae; segment III with 8 carinae; segments IV-V with dorsal carinae and punctuations; ventral aspect of segment V without granulations on the distal region. Intercarinal spaces smooth dorsally; weakly granular to almost smooth laterally and ventrally. Telson smooth, with some minor punctuations; aculeus longer than the vesicle and moderately curved; subaculear tooth absent. Cheliceral dentition characteristic of the family Buthidae (Vachon, 1963); movable finger with weakly

marked basal teeth; ventral aspect of both finger and manus with thin setae. Pedipalps: femur with five moderate to strong carinae, granular; patella with 6-7 well marked carinae; chela without carinae, smooth. Fixed and movable fingers with 8-9 rows of granules. Trichobothriotaxy: A-β; neobothriotaxy 'minorante'; absence of trichobothria $\mathbf{d_2}$ and $\mathbf{e_1}$ on femur (Vachon, 1974, 1975). Legs: tarsus with two rows of setae ventrally. Tibial and pedal spurs moderately marked.



Figs. 10-15. *Orthochirus arenicola* n. sp., male holotype. 10-11. Femur, dorsal (11) and internal (12) aspects. 12-13. Patella, dorsal (12) and external (13) aspects. 14-15. Chela, dorsal (14) and ventral (15) aspects.



Figs. 16-20. *Orthochirus vachoni*, male paratype from Somalia. 16-17. Femur, dorsal (16) and internal (17) aspects. 18. Patella, dorsal aspect. 19. Chela, ventral aspect. 20. Metasomal segment V and telson, lateral aspect.

Morphometric values (in mm) of the male holotype. Total length 14.55 (including telson length). Carapace: length 1.80; anterior width 1.40; posterior width 2.40. Mesosoma length 3.60. Metasomal segments: I, length 1.00; width 1.34; II, length 1.20; width 1.34; III, length 1.27; width 1.47; IV, length 1.67; width 1.54; V, length 2.07; width 1.54; depth 1.14. Telson length 1.94. Vesicle: width 0.67; depth 0.54. Pedipalp: femur, length 1.34; width 0.70; patella, length 1.74; width 0.67; chela, length 2.47; width 0.47; depth 0.54; movable finger length 1.67.

Note: taking in account the average total length (21 to 25 mm) of moderate-size *Orthochirus* species such as *O. tassili* Lourenço & Leguin, 2011, *O. atarensis* Lourenço & Leguin, 2011 or *O. minor* Lourenço, Duhem & Cloudsley-Thompson, 2012, and applying the theoretical morphometric growth factor for arthropods defined by Dyar (1890) and Przibram & Megusar (1912), it is possible to suggest that the described specimen is a third instar juvenile. This is excluding the pro-juvenile instar and counting only juvenile instar from I to IV for *Orthochirus* species which normally reach adulthood with 4 to 5 moults (Lourenço, 2002, 2007).

Figs. 21-22. *Orthochirus arenicola* n. sp., male holotype (21) and a male of *Orthochirus* sp. from southern Sinai, Egypt (22) under UV light, showing the absence of fluorescence reaction in the new species.

Ecological considerations on the type locality of the new species (Figs. 23-24)

Following the southeast Somalian coasts, the Hobyo Grassland and Shrubland ecoregions consist mainly of white and orange sand dunes dominated by perennial grasslands and sedges. A significate number (less than a thousand) of vascular plants are probably found in the area with also an important rate of endemics. This ecoregion is a long, narrow coastal strip running from south of Mogadishu to some 250 km N of Hobyo. The dunes can reach a maximum height of 60 m, and the dune field is about 10 to 15 km wide along its entire length. Inland, the habitat changes to dry savannah and semi-desert vegetation. Geologically, these are recently deposited sands over Precambrian basement rocks. Temperature varies little during the year and the climate is hot and dry, with mean maximum temperatures ranging from 30° to 33°C and mean minimum temperatures ranging from 21° to 27°C. Rainfall averages 200 mm annually. It is seasonal, with most rain falling within the period from April to June.

Fig. 23. Map of Somalia including close up of Mudug region, showing the type locality of *Orthochirus arenicola* n. sp. in Lidaan (also known as Hilalaye).

Phytogeographically this area is regarded as part of the Somali-Masai regional centre of endemism. The vegetation is mapped as deciduous bushland and thicket, although the main components are coastal dune grasslands with scattered bushes, herbs and shrublets (White, 1983; Davis *et al*., 1994). Along the coast, the bushy vegetation has been sandblasted by powerful winds to form a specialized community of low, dense thickets that has year-round low-level green growth due to the humidity of sea breezes (Kingdon, 1997).

Most of this area can be considered as a centre of endemism for plants (Friis, 1992; Davis *et al*., 1994; Lovett & Friis, 1996). However, even if the botanical studies started back to the end of the 19th century, no reliable estimates are available about the precise number of endemic plants. In fact, more recent political instability, and the

physical inaccessibility of the site have hindered explorations for several decades now. Plants have adapted to the climate in several ways and succulents are common. Many of the endemics are cushion plants shaped by the sand-laden winds (Davis *et al*., 1994). Due to the long-standing and continued political instability in Somalia, it is not known how much habitat remains in this ecoregion, or how fragmented it has become. The only official protected area is Lag Badana-Bushbush National Park, but this is undoubtedly no longer playing a major role in the protection of local biodiversity.

Fig. 24. Natural habitat of *Orthochirus arenicola* n. sp., showing the village of Lidaan and the sand beach where the new species was collected.

References

Davis, S.D., Heywood, V.H. & Hamilton, A.C. 1994. Editors. *Centres of plant diversity. Vol 1: Europe, Africa, Southwest Asia and the Middle East*. World Wide Fund for Nature and IUCN, Oxford, UK. 354 pp.

Dyar, H. 1890. The number of molts in Lepidopterous larvae. *Psyche*, 5: 420-422.

Fet, V. & Lowe, G. 2000. Family Buthidae C. L. Koch, 1837. Pp. 54-286. *In*: Fet, V., Sissom, W.D., Lowe, G. & Braunwalder, M.E. (eds.). *Catalog of the Scorpions of the world (1758-1998)*. New York, NY: The New York Entomological Society, 690 pp.

Friis, I. 1992. *Forests and Forest Trees of Northeast Tropical Africa*. HMSO, Kew Bulletin Additional Series XV.

Hjelle, J.T. 1990. Anatomy and morphology. Pp. 9-63. In: G.A. Polis (ed.), *The Biology of Scorpions*. Stanford University Press, 587 pp.

Kingdon, J. 1997. *The Kingdon Field Guide to African Mammals*. Academic Press, London. 464 pp.

Kovařík, F. 1998. Three new genera and species of Scorpiones (Buthidae) from Somalia. *Acta Soc. Zool. Bohem.*, 62: 115-124.

Kovařík, F., Fet, V. & Siyam, M. 2020a. Taxonomic position of *Orthochirus olivaceus* (Karsch, 1881), the type species of the genus *Orthochirus* Karsch, 1892 (Scorpiones: Buthidae). *Euscorpius*, 319: 1-15.

Kovařík, F., Lowe, G. & Šťáhlavský, F. 2016. Scorpions of the Horn of Africa (Arachnida: Scorpiones). Part IX. *Lanzatus*, *Orthochirus*, and *Somalicharmus* (Buthidae), with description of *Lanzatus somalilandus* sp. n. and *Orthochirus afar* sp. n. *Euscorpius*, 232: 1-38.

Kovařík, F., Lowe, G., Stockmann, M. & Šťáhlavský, F. 2020b. Revision of genus-group taxa in the family Scorpiopidae Kraepelin, 1905, with description of 15 new species (Arachnida: Scorpiones). *Euscorpius*, 325: 1-140.

Lourenço, W.R. 1980. Contribution à la connaissance systématique des scorpions appartenant au complexe *Tityus trivittatus* Kraepelin, 1898 (Buthidae). *Bulletin du Muséum national d'Histoire naturelle*, Paris, 4e sér., 2 (A3): 793-843.

Lourenço, W.R. 2002. Reproduction in scorpions, with special reference to parthenogenesis. Pp. 71-85. *In*: S. Toft & N. Scharff (eds.), *European Arachnology 2000*. Aarhus University Press, Aarhus.

Lourenço, W.R. 2007. Litter size in micro-buthoid scorpions (Chelicerata, Scorpiones). *Boletin de la Sociedad Entomológica Aragonesa*, 40: 473-477.

Lourenço, W.R. 2020. A remarkable new species of *Leiurus* Ehrenberg, 1828 from the North Deserts of Mali (Scorpiones: Buthidae). *Revista Ibérica de Aracnologia*, 37: 147-152.

Lourenço, W.R. & Leguin, E.-A. 2011a. Further considerations on the species of the genus *Orthochirus* Karsch, 1891 from Africa, with description of three new species (Scorpiones: Buthidae). *Euscorpius*, 116: 1-19.

Lourenço, W.R. & Leguin, E.-A. 2011b. One more new species of the genus *Orthochirus* Karsch, 1891 from Africa (Scorpiones: Buthidae). *Euscorpius*, 135: 1-6.

Lourenço, W.R. & Rossi, A. 2013. Confirmation of a new species of *Buthus* Leach, 1815 from Sicily (Scorpiones, Buthidae). Biogeographical implications. *Revista Ibérica de Aracnologia*, 22: 9-14.

Lourenço, W.R. & Sadine, S.E. 2021 (in press). A new contribution to the knowledge of the Algerian scorpion fauna with description of a new species of the genus *Orthochirus* Karsch, 1891 (Scorpiones: Buthidae). *Bulletin de la Société Entomologique de France*, 126(2): xx-xx.

Lourenço, W.R., Duhem, B. & Cloudsley-Thompson, J.L. 2012. Scorpions from Ennedi, Kapka and Tibesti the mountains of Chad, with descriptions of nine new species (Scorpiones: Buthidae, Scorpionidae). *Arthropoda Selecta*, 21(4): 307-338.

Lovett, J.C. & Friis, I. 1996. *Patterns of endemism in the woody flora of north-east and east Africa*. Pp. 582-601. *In*: L. J. G. van der Maesen *et al.* (eds.). The Biodiversity of African Plants. The Netherlands: Kluwer Academic Publishers.

Przibram, H. & Megusar, F. 1912. Wachstummessungen an *Sphodromantis bioculata* Burm. 1. Länge und Masse. *Archiv für Entwicklungsmechanik der Organismen*, 34: 680-741.

Stahnke, H.L. 1970. Scorpion nomenclature and mensuration. *Entomological News*, 81(12): 297-316.

Stewien, K.E. & Delgado, A. 1968. Estudios sobre las trichobotrias en escorpiones sudamericanos. 1. Verification de la constancia del caracter tricobotrial en la ontogenesis de *Tityus serrulatus* Lutz e Mello, 1922 y de *Tityus bahiensis* (Perty), 1834. *Revista peruana de entomologia*, 11(1): 80-84.

Vachon, M. 1952. *Etudes sur les scorpions*. Publications de l'Institut Pasteur d'Algérie, Alger: 482 pp.

Vachon, M. 1963. De l'utilité, en systématique, d'une nomenclature des dents des chélicères chez les Scorpions. *Bulletin du Muséum national d'Histoire naturelle*, Paris, 2e sér., 35(2): 161-166.

Vachon, M. 1974. Etude des caractères utilisés pour classer les familles et les genres de Scorpions (Arachnides). 1. La trichobothriotaxie en arachnologie. Sigles trichobothriaux et types de trichobothriotaxie chez les Scorpions. *Bulletin du Muséum national d'Histoire naturelle*, Paris, 3e sér., n° 140, Zool. 104: 857-958.

Vachon, M. 1975. Sur l'utilisation de la trichobothriotaxie du bras des pédipalpes des Scorpions (Arachnides) dans le classement des genres de la famille des Buthidae Simon. *Comptes Rendus des Séances de l'Académie de Sciences*, 281(D): 1597-1599.

White, F. 1983. *The vegetation of Africa, a descriptive memoir to accompany the UNESCO/AETFAT/UNSO Vegetation Map of Africa (3 Plates, Northwestern Africa, Northeastern Africa, and Southern Africa, 1:5000.000)*. UNESCO, Paris.

Orthochirus arenicola **Lourenço & Ythier, 2021**
urn:lsid:zoobank.org:act:790C0326-7281-4D6C-B427-D21B966996F1

Serket (2021) vol. 17(4): 350-359.

Gylippus (*Paragylippus*) *arikani* sp. nov. (Solifugae: Gylippidae: Gylippinae) from Turkey with comparative remarks on the species of the subgenus *Gylippus* (*Paragylippus*) Roewer

Halil Koç [1*] & Melek Erdek [2]

[1] Sinop University, Faculty of Arts and Science, Department of Biology, Sinop, Turkey

[*] Corresponding author e-mail address: koc.halil@hotmail.com

[2] Hakkâri University, Institute of Science, Biology Department, Hakkâri, Turkey

E-mail: melekerdek@hakkari.edu.tr

Abstract

A new species, *Gylippus* (*Paragylippus*) *arikani* sp. nov., (Solifugae, Gylippidae, Gylippinae) is described from Manisa and İzmir Provinces, Turkey. Cheliceral morphology and other characteristics of Gylippinae are discussed. Differences between the new species and related species are provided.

Keywords: Solifugae, camel spiders, Gylippidae, *Gylippus* (*Paragylippus*), new species, Turkey.

Introduction

The arachnid order Solifugae, commonly referred to as solifuges, sun-spiders, or camel spiders, currently consists of 1105 described species belong to 139 genera and 12 families (Bird *et al*., 2015; Bird & Wharton, 2015). Gylippidae Roewer, 1933 is a small family characterized by the peculiar male flagellum, which is a membranous strap like dorsal process of the dorsal fixed finger, the presence of dorsomedial spiniform setae in males, and the female genital operculum (as in eremobatids and karschiids) distinctly differentiated from other abdominal sternites and specifically variable (Muma, 1976; Erdek, 2015; Bird *et al*., 2015). Gylippidae consists of two subfamilies, Gylippinae Roewer, 1933 and Lipophaginae Wharton, 1981. This taxonomic discrimination is based on morphological data and supported by distribution data. Gylippinae comprises 20 species in four subgenera in *Gylippus*. *Gylippus* (*Paragylippus*) is so far known from

only five species, namely: *Gylippus* (*P.*) *afghanus* (Roewer, 1933) [from Afghanistan], *G.* (*P.*) *caucasicus* Birula, 1907 (with two subspecies: *G.* (*P.*) *caucasicus caucasicus* Birula, 1907 [from Armenia, Azerbaijan, Georgia] and *G.* (*P.*) *caucasicus koenigi* Birula, 1913 [from Turkey], *G.* (*P.*) *monoceros* Werner, 1905 [from Turkey], *G.* (*P.*) *quaestiunculoides* Birula, 1907 [from Iran] and *G.* (*P.*) *spinimanus* Birula, 1905 [from Iran].

Re-examination of new distribution records given for Western Anatolia by Koç (2011) has proven that his specimens identified as "*Gylippus* (*Paragylippus*) *monoceros* Werner, 1905" do not belong to this species but to an un-described species within the same genus and we describe it here as *Gylippus* (*Paragylippus*) *arikani* sp. nov.

Material and Methods

Specimens were hand-captured from under stones and collected with pitfall traps in Western Anatolia, Turkey. Specimens were examined and photographs were taken with a Canon EOS 70D digital camera. Cheliceral terminology follows Bird *et al*. (2015). Measurements are given in millimetres. For Scanning Electron Microscopy (SEM), specimens were kept overnight in absolute ethanol. After dehydration, specimens were gold coated in a Quorum SC7620 Sputter Coater. Morphological structures were studied and photographed at an accelerating voltage of 10kV with a ZEISS Sigma 300 scanning electron microscope at the Science Application and Research Center in Van Yüzüncü Yıl University. Specimens are deposited in the Solifugae collection at the Zoological Museum of Sinop University, Turkey (ZMSU). The distribution map was created using ArcGIS (version 10.3.1) (Fig. 1).

Results

Taxonomic Account

Family **Gylippidae** Roewer, 1933
Genus ***Gylippus*** Simon, 1879
Subgenus ***Gylippus* (*Paragylippus*)** Roewer, 1933
Species ***Gylippus* (*Paragylippus*) *arikani*** sp. nov. (Figs. 2-5, Table 1)

Gylippus (*Paragylippus*) *monoceros* Werner, 1905: Koç, 2011 (misidentified).

Type material. Holotype: **Turkey**, **İzmir Prov.**, Ödemiş Distr., NW slope of Bozdağ Mt. Range, c. 1.7 km SE of Bozdağ, c. 1.5 km WNW of Bozdağ Ski Center, N 38°20'23.06", E 28°06'32.03", 1501 m, 18.v.2013, leg. E.A. Yağmur, ♂ (ZMSU/Sol-Gyl:1031). Paratypes: **Turkey**, **İzmir Prov.**; Ödemiş Distr., NW slope of Bozdağ Mt. Range, c. 1.7 km SE of Bozdağ, c. 1.5 km WNW of Bozdağ Ski Center, N 38°20'23.06", E 28°06'32.03", 1501 m, 18.v.2013, leg. E.A. Yağmur, 1♀ (ZMSU/Sol-Gyl:1031); Ödemiş Distr., S slope of Bozdağ Mt. Range, c. 1.5 km N of Kemerköy Village, 3 km E of Gölcük Lake, N 38°18'23.67", E 28°05'54.33", c. 1651 m, 23.v.2010, leg. H. Koç, 1♂ (ZMSU/Sol-Gyl:1032); Bornova Distr., NNW slope of Yamanlar Mt., 5 km NW of Sarnıçköy Village, near Karagöl Lake, N 38°33'27", E 27°13'14", 839 m, pitfall trap, 17.iv-24.xi.2017, leg. E.A. Yağmur, 1 juv. (ZMSU/Sol-Gyl:1033); Bornova Distr., NW slope of Nif Mt., 5 km W of Gökdere Village, N 38°23'04", E 27°11'18", 1452 m, pitfall trap, 17.iv-22.x.2017, leg. E.A. Yağmur, 2♀, 7 juv. (ZMSU/Sol-Gyl: 1037); Kemalpaşa Distr., Spil Mt., 5 km NW of Beşpınar Village, N 38°33'11", E 27°25'57", 1185 m, pitfall

trap, 26.vi-16.x.2016, leg. E.A. Yağmur, 7 juv. (ZMSU/Sol-Gyl:1017); Kemalpaşa Distr., Spil Mt., 2 km NNE of Beşpınar Village, N 38°32'17", E 27°27'36", 1119 m, pitfall trap, 26.vi-16.x.2016, leg. E.A. Yağmur, 5 juv. (ZMSU/Sol-Gyl:1018); Kemalpaşa Distr., Spil Mt., 2.5 km NNW of Beşpınar Village, N 38°32'30", E 27°26'46", 1125 m, pitfall trap, 26.vi-16.x.2016, leg. E.A. Yağmur, 1♀ (ZMSU/Sol-Gyl:1019); Kemalpaşa Distr., Spil Mt., 2 km NNW of Beşpınar Village, N 38°32'17", E 27°27'36", 1119 m, pitfall trap, 20.iv-16.vi.2016, leg. E.A. Yağmur, 1♀ (ZMSU/Sol-Gyl:1020); Ödemiş Distr., Gölcük road, Bozdağlar Mt., N 38°18'11", E 28°02'06.7", 1211 m, 02-28.vi.2012, leg. E.A. Yağmur, 1♀ (ZMSU/Sol-Gyl:1022); Ödemiş Distr., peak of Bozdağ Mt. Range, c. 16 km NNE of Ödemiş, c. 2 km SE of Bozdağ Ski Center, N 38°19'30.9", E 28°06'1.3", 2115 m, 01.vi.2008, leg. H. Koç, 2♀ (ZMSU/Sol-Gyl:1024); S slope of Bozdağ Mt. Range, c. 9.5 km NNE of Ödemiş, W env. of Gedikdüzü [=Gölcük], N 38°19'10", E 28°01'05", c. 1150 m, under stones, 09.v.2006, leg. B. Gülcü & Z. Piliç, 1♂, 1♀ (ZMSU/Sol-Gyl:1025); NW slope of Bozdağ Mt. Range, c. 1.5 km SE of Bozdağ, c. 1.3 km WNW of Bozdağ Ski Center, N 38°19'55", E 28°05'25", c. 1400 m, under stone, 21.v.2006, leg. H. Koç, 1♂ (AGC); As previous, 1 juv. (ZMSU/Sol-Gyl:1026). **Manisa Prov.;** 1 juv. (ZMSU/Sol-Gyl: 1036); Turgutlu Distr., 1.5 km E of Kuşlar Village, N 38°21'24", E 27°50'38", 1006 m, pitfall trap, 20.vi.2016-24.iii.2017, leg. S. Anlaş. 2♀ (ZMSU/Sol-Gyl:1021); Turgutlu Distr., 1.5 km E of Kuşlar Village, N 38°21'24", E 27°50'38", 1006 m, pitfall trap, 10.v-26.vi.2016, leg. E.A. Yağmur. 1♂, 3♀ (ZMSU/Sol-Gyl:1023); Turgutlu Distr., Dağmarmara Village, N 38°21'10"; E 27°51'02", 1037 m, 10.v-27.vi.2016, leg. E.A. Yağmur. 1 juv. (ZMSU/Sol-Gyl:1027); Turgutlu Distr., 1.5 km E of Karaköy Village, N 38°20'09", E 27°50'47", c. 1053 m, 12.x.2003, leg. S. Anlaş. 1♀ (ZMSU/Sol-Gyl:1028); Turgutlu Distr., 1 km E of Karaköy Village, N 38°20'09.15", E 27°50'38.38", c. 974 m, 17.vi.2006, leg. H. Koç. 1♂ (ZMSU/Sol-Gyl:1029); Salihli Distr., 2 km SE of Bahçecik Village, N 38°24'46", E 28°08'01", c. 939 m, 04.v.2014, leg. E.A. Yağmur. 1♀ (ZMSU/Sol-Gyl:1030); Salihli Distr., 2 km SW of Bahçecik Village, N 38°24'39", E 28°04'26", c. 1322 m, 04.v.2014, leg. E.A. Yağmur.

Fig. 1. Distribution map of *Gylippus* (*Paragylippus*) *arikani* sp. nov. in Manisa and İzmir Provinces, Turkey.

Fig. 2. *Gylippus* (*Paragylippus*) *arikani* sp. nov., habitus. A, C. male holotype. B, D. female paratype. A-B. dorsal view. C-D. ventral view. (Scale bar: 5 mm).

Etymology. This new species is named after Prof. Dr. Hüseyin Arikan who has conducted important zoological research in Turkey.

Diagnosis. The relatively "S" shaped strap like flagellum, presence of one dorsally situated retrolateral manus spiniform seta, one flagellar complex spiniform seta, and 4–6 dorsomedial spiniform setae on the dorsal fixed finger in males and the posteriorly oval or rounded distinct bulges on the genital sternite in females conform to the diagnostic characters of *Gylippus* (*Paragylippus*). However, it is more difficult to compare our new species to consubgeneric species, because of rather poor and inadequate illustrations in the literature. *G.* (*P.*) *arikani* sp. nov. can be readily recognized from its congeners by the following characters: shape of male cheliceral flagellum (cf. Figs. 3B-E; 5A-C; Birula,

1913: Pl. VII Fig. 3; Roewer, 1933: Figs. 229A1-A2), shape of retrolateral manus spiniform seta, flagellar complex spiniform seta, and dentition of dorsal fixed finger in males (cf. Figs. 3A, C, Birula, 1913: Pl. VII Fig. 3; Roewer, 1933: Figs. 229A1-A2), general colouration and more differentiated genital sternites in females (cf. Figs. 4D, F; Birula, 1913: Pl. VII Fig. 4; Pl. VIII Figs. 3, 9; Roewer, 1933: Figs. 230A-C).

Overall, *Gylippus* (*Paragylippus*) *arikani* sp. nov. is most similar to *G.* (*P.*) *monoceros* Werner 1905. However, these two species differ greatly in body colouration, chelicerae-propeltidium width, flagellum angle and setal disparities. The colour of male *G. (P.) arikani* sp. nov. is generally darker brownish-gray than male *G.* (*P.*) *monoceros,* while female *G.* (*P.*) *arikani* sp. nov. has lighter yellow-brownish dorsal body colouration than *G.* (*P.*) *monoceros* females especially on the lateral sides of the abdomen. Chelicerae and propeltidium of male *G.* (*P.*) *arikani* sp. nov. are narrower than male *G.* (*P.*) *monoceros*'s (in dorsal view). The tip of the "S"-shaped flagellum in *G.* (*P.*) *arikani* sp. nov. is dorsally curled downwards more than in *G.* (*P.*) *monoceros.* Distance between tip of fixed finger and flagellum originates from fixed finger in *G.* (*P.*) *arikani* sp. nov. and is longer than in *G.* (*P.*) *monoceros*. Flagellar complex spiniform seta and retrolateral manus spiniform seta in *G.* (*P.*) *arikani* sp. nov. points retrolaterally "more" upwards and darker than in *G.* (*P.*) *monoceros*. Dorsomedial spiniform setae in *G.* (*P.*) *arikani* sp. nov. are denser and longer than in *G.* (*P.*) *monoceros*.

Distribution. Manisa and İzmir Provinces, Turkey.

Ecology. The specimens were found in humid clay foothills and mountain slopes covered by sparse scrublands. Adults were most likely present from early May until the end of June.

Description.

Male (holotype)

Colour: General background brownish-yellow. Mesopeltidium, metapeltidium and abdominal tergites laterally fawn-coloured, dorsomedially blackish-brown and ventrally yellowish. Propeltidium brown with dark reddish-brown spots occurring in different pigment densities. Legs generally brownish; distal and dorsal portion of femur, tibia, metatarsus and tarsus dark brownish. Cheliceral fingers, retrolateral manus spiniform seta, flagellar complex spiniform seta, and retrolateral manus setae, palp femoral setae, some setae on propeltidium reddish-brown and tip of the cheliceral fingers reddish-dark brown. Malleoli entirely yellow (Figs. 2A, C; 3A-F).

Propeltidium (Fig. 3A): Entire surface covered with dark brown pigmentation in different density, dense perpendicular short hairs and several long curved hairs. Anterior edge of propeltidium blackish-brown. Ocular tubercle black, smooth and carrying a pair of long setae on its anterior edge.

Chelicerae (Figs. 3A-E): Dorsal side of each chelicerae with two dark brown pigmentation lines. The one line starting behind the retrolateral manus spiniform seta and the other located internal dorsolaterally. Movable finger distally curved inward, fixed finger flattened. Dentition: Fixed finger with 1 shrunken distal tooth, 1 shrunken medial tooth, 1 submedial tooth, 1 proximal tooth, 1 profondal proximal tooth, 1 profondal medial tooth, 1 retrofondal medial tooth, 1 retrofondal submedial tooth, 1 retrofondal proximal tooth and 1 retrofondal subproximal tooth (5 small pieced). Movable finger with 1 medial tooth, 1 submedial tooth and 1 proximal tooth. "S" shaped flagellum (Figs. 3B-E) membranous, narrowing from lateral sides and pointed distally. Dorsal surface of flagellum with numerous epicuticular protrusions. Retrolateral manus spiniform seta (1.22 mm) located dorsolaterally on the immovable finger and slightly curved upwards.

Flagellar complex spiniform seta (0.67 mm) sickle shaped, bent down distally. Laterally on chelicera, 6 distinct retrolateral manus setae, five of which are remarkably thick and one of which is dorsolaterally long and thicker than the others. Entire cheliceral surface covered with numerous filiform and bifurcate hairs. Stridulatory plates smooth and located proximally on the inner side of each chelicera. There are four prodorsal distal setae dorsal to the stridulatory plate. Prolateral side of the chelicera with several long, plumose setae and 8 proventral subdistal setae behind the plumose setae.

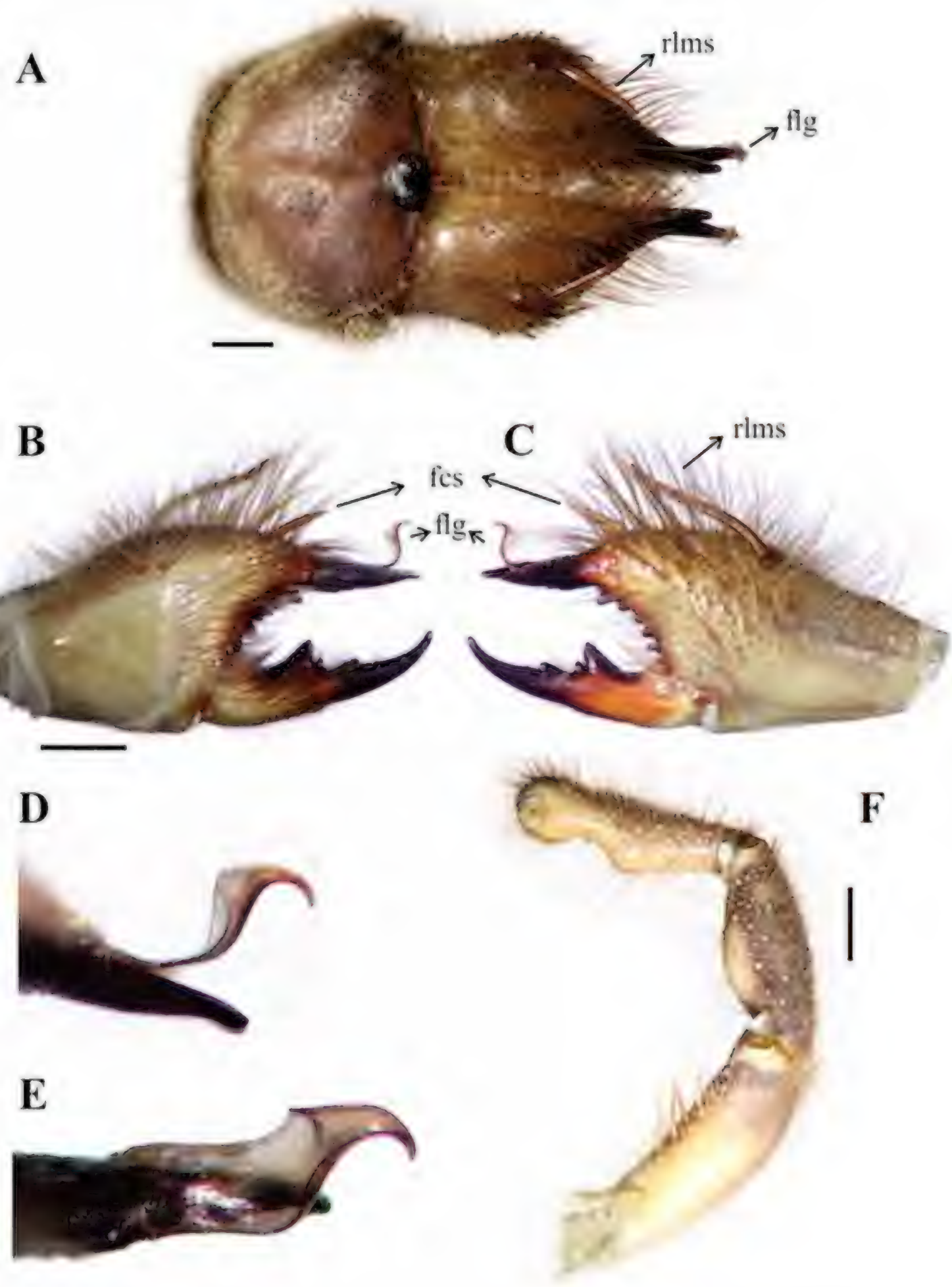


Fig. 3. *Gylippus* (*Paragylippus*) *arikani* sp. nov. male holotype (ZMSU/Sol-Gyl:1031). A. chelicerae and propeltidium, dorsal view. B-C. sinistral chelicera. B. prolateral view. C. retrolateral view. D-E. flagellum. D. prolateral view. E. dorsal view. F. dextral pedipalp. Abbreviations: fcs = flagellar complex spiniform seta, flg = flagellum, rlms = retrolateral manus spiniform seta. (Scale bars: 1 mm).

Abdomen: Entire surface covered with numerous, long bifurcated setae. Abdominal sternites without ctenidia.
Pedipalps (Figs. 2A, C; 3F): Metatarsus swollen. Metatarsal length/width: 2.08 mm/0.92 mm. Pedipalps covered with numerous short hairs and long setae, the latter especially on the metatarsal surface. Mesal surface of femur with four orange-reddish robust thick spine-like setae shorter than diameter of femur and one long, thin, distinctive seta proximally behind the spine-like setae.
Legs: Leg I spineless with tarsal claws well-developed. Metatarsi II and III with two spine-like setae dorsally and five pairs of thin setae ventrally. Leg surfaces covered with numerous, dense, thin hairs.
Morphological details of males (chelicera and pedipalp) pointed out in Fig. 5 on a paratype male.

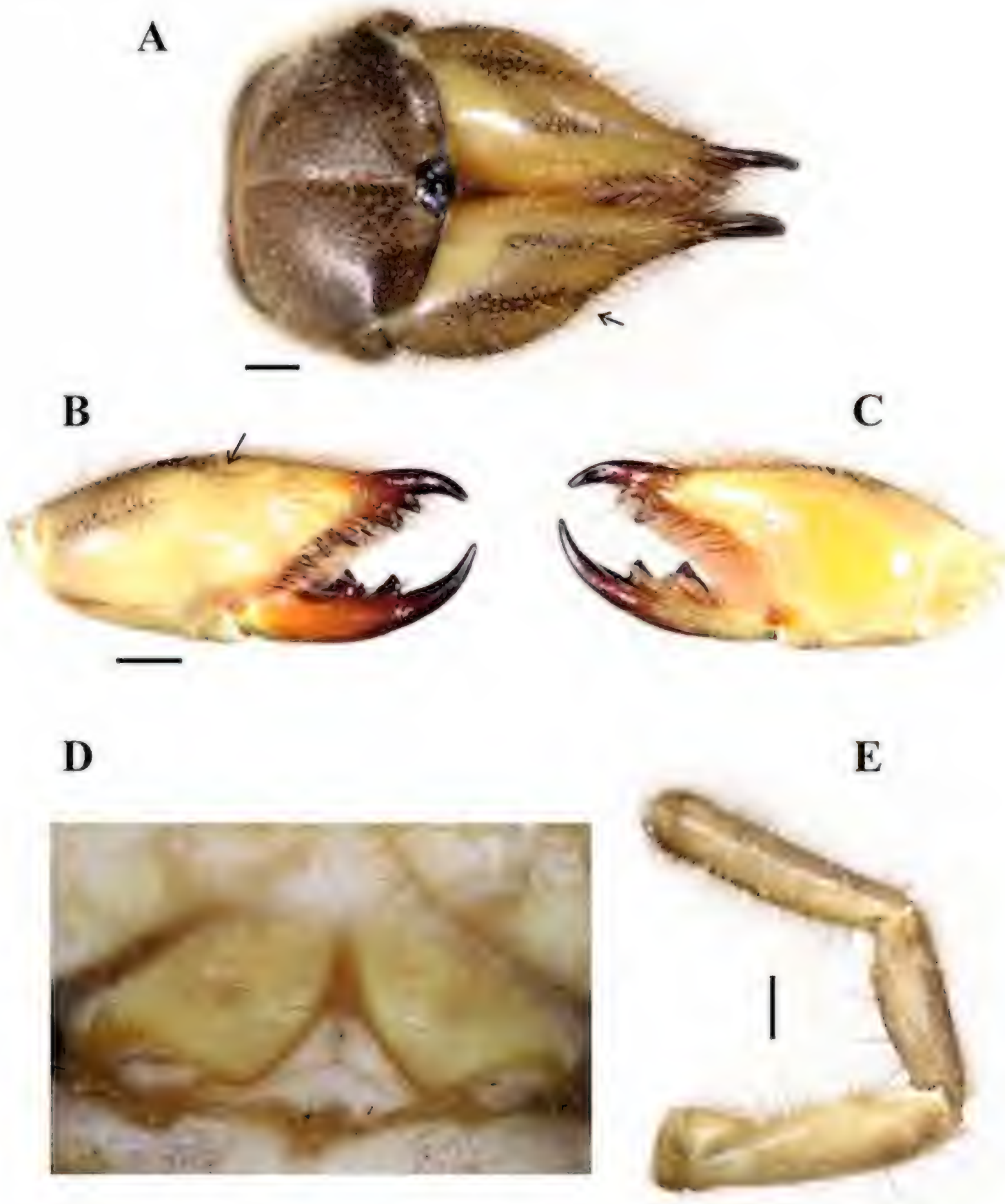


Fig. 4. *Gylippus* (*Paragylippus*) *arikani* sp. nov. female paratype. A. chelicerae and propeltidium, dorsal view. B-C. dextral chelicera. B. retrolateral view. C. prolateral view. D. genital sternite, ventral view. E. dextral pedipalp. (Arrow shows that the seta in female is homologous to retrolateral manus spiniform seta in male). (Scale bars: 1 mm).

Female (Paratype) (Fig. 4): General body colouration slightly darker than in males (Fig. 2). Unlike males, pedipalps not swollen and no distinctive setae, covered with some sparse long and dense short thin hairs with blackish-brown pigmentation (Fig. 4B). Chelicerae with thin and less hairs. Propeltidium dorsal pigmentation distinctive, dark brown and general pattern as in Fig. (4A). Dentition: Fixed finger with 1 distal tooth - 1 medial tooth - 1 submedial tooth - 1 proximal tooth - 1 profondal proximal tooth - 1 profondal medial tooth - 1 retrofondal medial tooth - 2 retrofondal submedial teeth - 1 retrofondal proximal tooth - 5 pieced in 1 retrofondal subproximal tooth. Movable finger with 1 medial tooth - 1 submedial tooth - 1 proximal tooth. Row of three profondal teeth (1 prefondal medial tooth - 1 profondal submedial tooth - 1 profondal proximal tooth) followed by a separate tooth anterior to it on the inner face of fixed finger. Outer lateral side of chelicerae as in Fig. (4C). Genital sternites strongly sclerotized; covered with long and dense setae and forming two distinct, hairy protuberant triangular lobes on both side of genital opening (Fig. 4D).

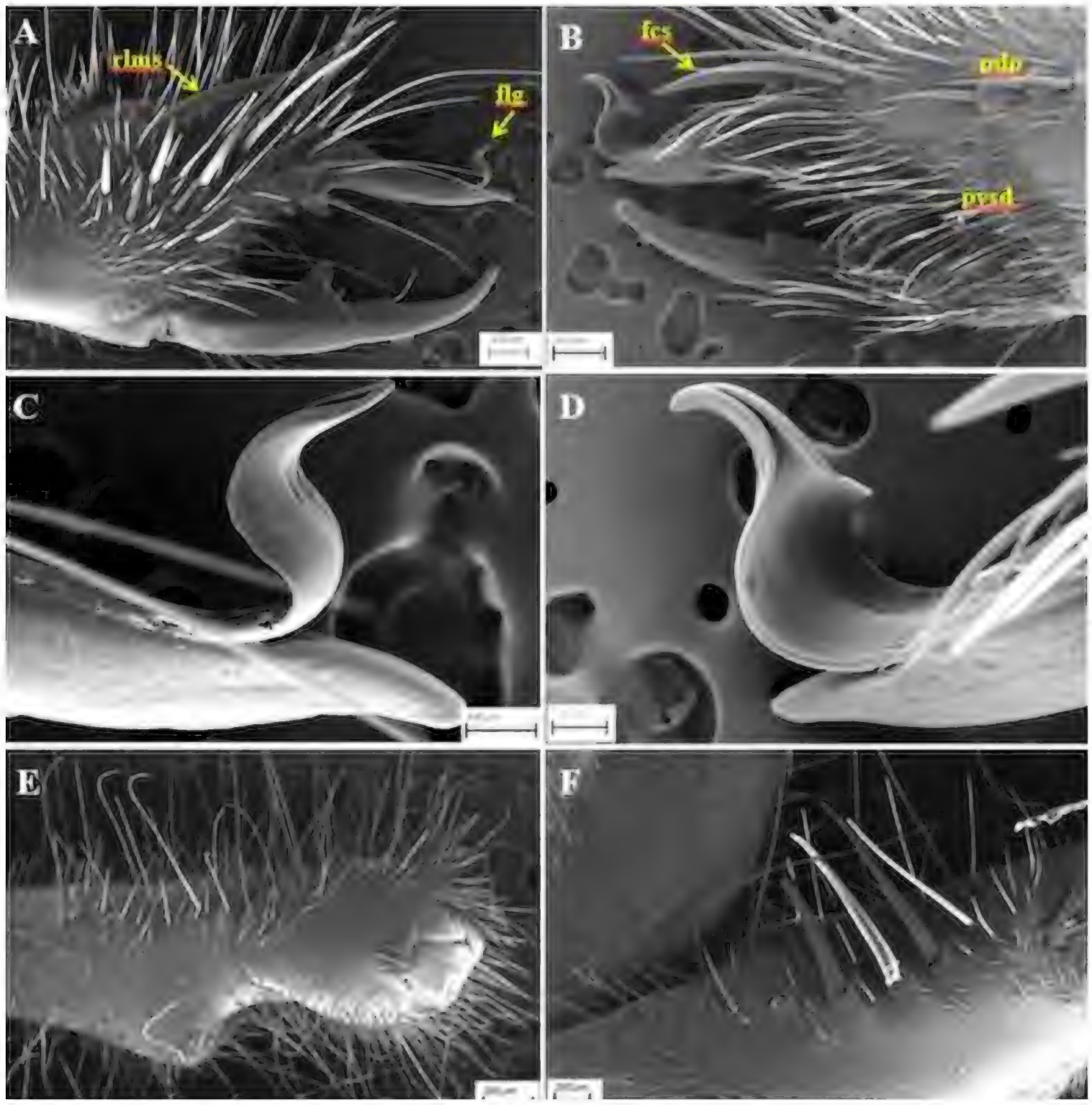


Fig. 5. SEM images of *Gylippus* (*Paragylippus*) *arikani* sp. nov. male paratype. A. dextral chelicera, retrolateral view. B. sinistral chelicera, prolateral view. C-D. flagellum. C. retrolateral view. D. dorsal view. E. dextral pedipalp, tarsus and metatarsus. F. dextral pedipalp, femur with femoral setae. Abbreviations: fcs = flagellar complex spiniform seta, flg = flagellum, pdp = prodorsal distal setae, pvsd = proventral subdistal setae, rlms = retrolateral manus spiniform seta.

Table 1. Measurements of *Gylippus* (*Paragylippus*) *arikani* sp. nov. (♂ holotype / ♀ paratype, in mm).

	Length			**Width**		
Total	17.31/19.05			-		
Chelicerae	4.45/5.48			1.81/2.09		
Propeltidium	3.16/3.27			4.13/4.91		
Appendages	**Total (with coxa)**	**Femur**	**Tibia**	**Metatarsus**	**Tarsus**	**Claw**
Palp	13.01/12.30	4.17/3.52	3.16/2.90	2.36/2.54	0.92/1.09	
Leg I	11.53/11.52	2.72/3.05	2.80/2.71	1.93/1.88	1.34/1.30	0.09/0.10
Leg II	10.54/10.05	1.97/1.91	2.20/1.88	1.54/1.45	0.78/0.78	0.72/0.69
Leg III	12.57/12.24	2.65/2.51	2.87/2.74	1.89/1.86	0.87/0.81	0.74/0.87
Leg IV	17.76/17.93	3.68/3.46	4.04/3.86	2.90/2.68	1.40/1.45	1.12/1.23

Discussion

Six gylippid species of subfamily Gylippinae, comprising three subgenera in *Gylippus*, occur in Turkey (Harvey, 2003; Erdek, 2015; Koç & Erdek, 2019): *Gylippus* (*Gylippus*) *erseni* Koç & Erdek, 2019, *Gylippus* (*G.*) *quaestiunculus* Karsch, 1880, *Gylippus* (*G.*) *syriacus* (Simon, 1872), *Gylippus* (*Hemigylippus*) *bayrami* Erdek, 2014, *Gylippus* (*Paragylippus*) *caucasicus koenigi* Birula, 1913, *Gylippus* (*Paragylippus*) *monoceros* Werner, 1905. The number of the species of the genus *Gylippus* becomes seven in Turkey with the present description in this paper.

A thickened seta visible on the retrolateral surface of the chelicerae in some females is homologous to retrolateral manus spiniform seta in males (Bird *et al.*, 2015). We also observed this thin seta in females (Figs. 4A-B, shown by an arrow) and were able to confirm its homology to the retrolateral manus spiniform seta in males.

Acknowledgments

We wish to thank Dr. Ersen Aydın Yağmur and Dr. Sinan Anlaş (Celal Bayar University) for providing some specimens.

References

Bird, T.L. & Wharton R.A. 2015. Description of a new solifuge *Melanoblossia ansie* sp. n. (Solifugae, Melanoblossiidae) with notes on the setiform flagellar complex of Melanoblossiinae Roewer, 1933. *African Invertebrates*, 56(2): 515-525.

Bird, T.L., Wharton, R.A. & Prendini, L. 2015. Cheliceral morphology in Solifugae (Arachnida): Primary homology, terminology, and character survey. *Bulletin of the American Museum of Natural History*, 394: 1-355.

Birula, A.A. 1913. Monographie der Solifugen-Gattung *Gylippus* Simon. *Annuaire du Musée Zoologique de l'Académie des Sciences de St.-Pétersbourg*, 18: 317-400, tables 7-11.

Erdek, M. 2015. *Gylippus* (*Hemigylippus*) *bayrami* sp. n. from Turkey with comparative remarks on the species of the subgenus *Gylippus* (*Hemigylippus*) Birula (Solifugae: Gylippidae). *Zoology in the Middle East*, 61(1): 69-75.

Harvey, M.S. 2003. *Catalogue of the smaller arachnid orders of the world. Amblypygi, Uropygi, Schizomida, Palpigradi, Ricinulei and Solifugae*. xi+385 pp. CSIRO Publishing, Collingwood, Australia.

Koç, H. 2011. New record of *Gylippus* (*Paragylippus*) *monoceros* Werner, 1905 (Solifugae: Gylippidae) in Western Anatolia, Turkey. *Biharean Biologist*, 5(2): 119-122.

Koç, H. & Erdek, M. 2019. *Gylippus* (*Gylippus*) *erseni* sp. n. (Solifugae: Gylippidae: Gylippinae), a new solifuge species from Turkey. *Acta Zoologica Bulgarica*, 71(2): 159-166.

Muma, M.H. 1976. *A review of solpugid families with an annotated list of Western hemisphere solpugids*. A publication of the Office of Research, Western New Mexico University, 2(1): 1-33.

Roewer, C.F. 1933. Solifugae, Palpigradi. *In* E.G. Bronn (editor), *Klassen und Ordnungen des Tierreichs. 5: Arthropoda. IV: Arachnoidea und kleinere ihnen nahegestellte Arthropodengruppen*. Vol. 5 (IV) (4) (2–3): 161–480. Leipzig: Akademische Verlagsgesellschaft M.B.H.

Gylippus arikani **Koç & Erdek, 2021**
urn:lsid:zoobank.org:act:A89972E0-528E-4512-A343-24165D38A313

Gylippus **(*Paragylippus*)** ***arikani*** **Koç & Erdek, 2021**
urn:lsid:zoobank.org:act:8AB89C9F-3105-4FC3-B480-F3B3E24D7CC3

Serket (2021) vol. 17(4): 360-362.

A new distribution record for *Encyocratella olivacea* Strand, 1907 from Tanzania (Araneae: Theraphosidae)

Danniella Sherwood [1*] & Michele Menegon [2,3]
[1] Arachnology Research Association, United Kingdom
[2] Division of Biology & Conservation Ecology, School of Science & the Environment, Manchester Metropolitan University, United Kingdom
[3] PAMS Foundation, P.O. Box 16556, Arusha, Tanzania
[*] Corresponding author e-mail address: danni.sherwood@hotmail.com

Abstract

A specimen of the Tanzanian endemic stromatopelmine *Encyocratella olivacea* Strand, 1907 observed in the Nguru mountains by the second author is detailed and illustrated, representing a novel and southernmost distribution record for this remarkable theraphosid spider.

Keywords: distribution, locality, biogeography, tarantula, Tanzania.

Encyocratella olivacea Strand, 1907 was originally described by Strand (1907a) from a single female from Amani, Tanzania. In the same year, Strand (1907b) also provided another textual description of the species. Many years later, Raven (1985) synonymised *Encyocratella* Strand, 1907 with the genus *Chaetopelma* Ausserer, 1871 but did not notice that this created a homonym as the generotype of *Chaetopelma* was *C. olivaceum* (C.L. Koch, 1841) from Egypt. This was also overlooked by Smith (1990) who also referred to the Tanzanian species as *C. olivacea*. Schmidt (1991) noticed the homonym and gave the replacement name *Chaetopelma strandi* Schmidt, 1991 to the Tanzanian taxon. Gallon (2003) described the novel genus *Xenodendrophila* Gallon, 2003 with its monotypic generotype *X. gabrieli* Gallon, 2003 based on female specimens from "mountains near" Arusha, Tanzania, which lacked spermathecae. Most recently, Gallon (2005) described the male, and synonymised *X. gabrieli* with *E. olivacea*, simultaneously removing the genus *Encyocratella* from its prior erroneous synonymy with *Chaetopelma*. Thus, until the present contribution, the distribution of *E. olivacea* has been known from only two localities.

Fig. 1. *Encyocratella olivacea* Strand, 1907 habitus of specimen in Nguru Mountains. Photo credit: Michele Menegon.

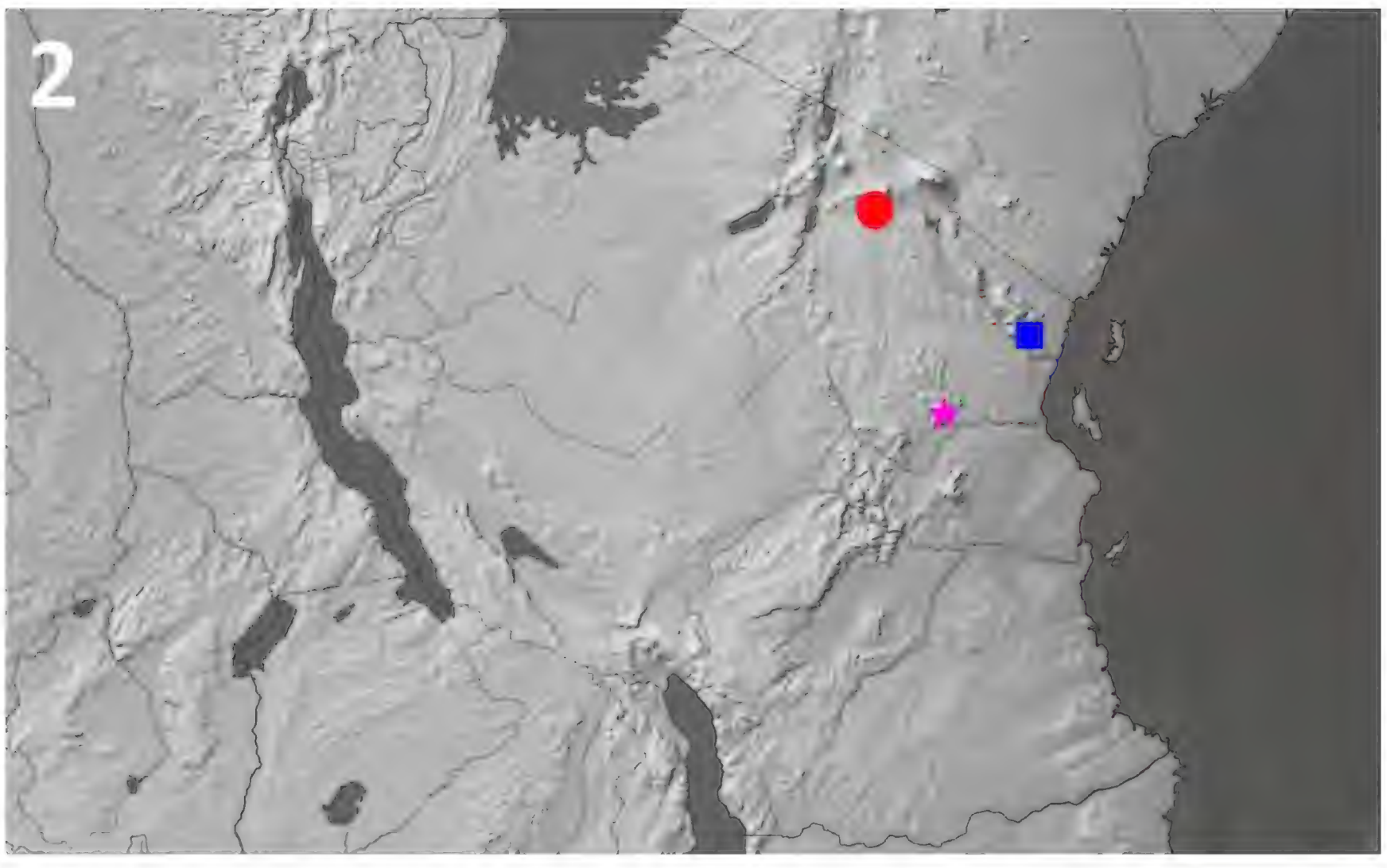


Fig. 2. Map of the known distribution of *Encyocratella olivacea* Strand, 1907, red circle = type locality of *Xenodendrophila gabrieli*, blue square = type locality of *E. olivacea*, pink star = new distribution record in this work. The distribution map was made using SimpleMappr (Shorthouse, 2010).

On 05/01/2021 the second author observed a specimen of *E. olivacea* on a tree (Fig. 1) on the eastern side of the Nguru mountains (approximately -6.108117 S, 37.530043 E) at around 1200 m a.s.l. at 17:53 East African Time. A photograph of the specimen was taken and uploaded to the website "iNaturalist" where it was brought to the attention of the first author (who is very familiar with this species having examined the type material of *X. gabrieli* and topotypes of *E. olivacea*, in addition to seeing live specimens of both sexes) thanks to notification from Kenyan naturalist Zarek Cockar. The specimen can be easily identified as *E. olivacea* based on the opisthosomal pattern and the colouration of the dorsal aspect of legs I–IV. Unlike some other African theraphosids, this species is distinctive in habitus and can be confidently identified from photographs (with accurate locality data). Given that subadult males and adult females of *E. olivacea* can be similar in size (DS pers. obs.) determination of the sex of the specimen was not possible from the photograph, though we can confidently state it is not a mature male, due to the non-modified palpal tarsi and absence of palpal emboli. The record reported herein represents a novel locality for *E. olivacea*, extending its known distribution over 160 km south-west of the type locality (Fig. 2). This well demonstrates that much is still to be discovered about the distribution of African theraphosid spiders.

Acknowledgment

We would like to thank Richard Gallon (United Kingdom) for his comments which improved the manuscript.

References

Ausserer, A. 1871. Beiträge zur Kenntniss der Arachniden-Familie der Territelariae Thorell (Mygalidae Autor). *Verhandlungen der Kaiserlich-Königlichen Zoologisch-Botanischen Gesellschaft in Wien*, 21: 117-224, pl. I.

Gallon, R.C. 2003. A new African arboreal genus and species of theraphosid spider (Araneae, Theraphosidae, Stromatopelminae) which lacks spermathecae. *Bulletin of the British Arachnological Society*, 12(9): 405-411.

Gallon, R.C. 2005. *Encyocratella olivacea* Strand, 1907, a senior synonym of *Xenodendrophila gabrieli* Gallon, 2003 (Araneae: Theraphosidae: Stromatopelminae) with a description of the male. *Zootaxa*, 1003: 45-56.

Koch, C.L. 1841. *Die Arachniden*. C. H. Zeh'sche Buchhandlung, Nürnberg, Achter Band, pp. 41-131, pl. 265-288 (f. 621-694); Neunter Band, pp. 1-56, pl. 289-306 (f. 695-726).

Raven, R.J. 1985. The spider infraorder Mygalomorphae (Araneae): cladistics and systematics. *Bulletin of the American Museum of Natural History*, 182: 1-180.

Schmidt, G. 1991. Zur Stellung von *Encyocratella olivacea* Strand 1907 im System. *Arachnologischer Anzeiger*, 15: 13.

Shorthouse, D.P. 2010. *SimpleMappr, an online tool to produce publication-quality point maps*, online at https://www.simplemappr.net.

Smith, A.M. 1990. *Baboon spiders: Tarantulas of Africa and the Middle East*. Fitzgerald Publishing, London, pp. 1-142.

Strand, E. 1907a. Vorläufige Diagnosen afrikanischer und südamerikanischer Spinnen. *Zoologischer Anzeiger*, 31: 525-558.

Strand, E. 1907b. Afrikanische und südamerikanische Avicullariiden, hauptsächlich aus dem naturhistorischen Museum zu Lübeck. *Zeitschrift für Naturwissenschaften*, 79: 170-266.

Serket (2021) vol. 17(4): 363-369.

On the biotopic distribution of spiders (Aranei) in the foothill of the southeastern slope of the Greater Caucasus

Nizami E. Novruzov
Institute of Zoology of the National Academy of Sciences of Azerbaijan,
Abbaszadeh str., 1128th side street, 504th block, Baku, Az 1073, Azerbaijan
E-mail: niznovzoo@mail.ru

Abstract

The biotopic distribution of spiders in the foothill part of the southeastern slope of the Greater Caucasian Ridge has been studied. The census of the number and determination of the species composition of the araneofauna was carried out, with the establishment of the degree of dominance of each of the species in biotopes differing in the type of soil, relief of the earth's surface, and the abundance of vegetation cover. In total, 68 species of spiders belonging to 14 families were noted during the research. The revealed eudominant, dominant, and subdominant groups of species were noted in areas of biotopes with typical microstacial conditions. The degree of dominance of species in each of the biotopes is presumably related to the presence of microstations in them, which create the possibility of a wide choice of microbiotic conditions.

Keywords: spiders, species composition, abundance, biotopic distribution.

Introduction

Biotopic distribution is one of the most important aspects of research and a less studied level of animal distribution, which makes it possible to reveal the factors and mechanisms that affect the segregation of ecological niches. In entomology, these aspects have been most studied for ground beetles (Carabidae) (Kassandrova, 1970; Matalin, 1997; Sharova & Kiselev, 1999; Gryuntal, 2008). In arachnology, similar studies were also carried out in different geographic areas (Bonn & Kleinwachter, 1999; Omelko, 2010; Simonov, 2017). Some data on the distribution of spiders in seven foothill parts of the southeastern slopes of the Greater Caucasus from some of them are present in

faunistic works (Dunin, 1989; Alieva, 2010a, 2010b; Nuruyeva & Huseynov, 2011). But special studies on the biotopic distribution of spiders in this region of Azerbaijan have not yet been carried out.

The purpose of this study was to study the abundance and biotopic distribution of spiders in different biotopes with differences in soil type, the relief of the earth's surface, the abundance of vegetation cover on a separate semi-desert territory of the Gobustan low-mountain spurs (hereinafter Gobustan), located between the extreme southeastern spurs of the Greater Caucasus and the Caspian Sea. For research in the southeastern region of Gobustan, a combination of desert, semi-desert, and steppe landscapes was combined; there was a specific hilly relief with ravines, gullies, ridge-aggregated clusters of rocky outliers, with a meagre vegetation cover consisting of spring ephemera, sagebrushes, saltwort, small shrubs and tree species (Budagov & Mikailov, 1985). In this territory, according to the literature, up to 137 species of spiders belonging to 27 families are reported (Alieva, 2010a).

To achieve this goal, the following tasks were solved: identifying the taxonomic composition of the spider fauna, determining the abundance and degree of dominance of species throughout the territory under consideration and in its individual biotopes, which differ in a certain set of microstational differences, mainly associated with the presence of ground shelters, the abundance, and nature of the distribution of vegetation cover.

Table 1. Landscape characteristics of the studied biotopes.

Biotope	Soil type	Landscape characteristics	Vegetation cover
I	Sandy	loose, hilly and semi-fixed sands interspersed with pebbles, rare stones and fragments of remnant rocks	sparse ephemeral, halophytic and psammophytic vegetation
II	Gray soil and loamy-gray soil	plain with temporary bodies of water and salt marshes	xerophytic, ephemeral and annual cereal, semi-aquatic and semi-aquatic vegetation
III	Loamy interspersed with sandy areas	spaces (takyrs) practically devoid of stones; burrows of small rodents were noted from shelters	rare ephemeral and halophytic vegetation
IV	Gray soil earth-stony	hillsides and gentle rocky slopes of the plateau	meadow-shrub zone, xerophytic, mainly wormwood-cereal, less often - small shrub vegetation
V	Gray soil	dry steppe zone, hilly valley cut by ravines with focal accumulations of stones and rocky outcrops of remnants	xerophytic herbaceous, shrubby and rare woody vegetation
VI	Loamy-gray soil	steep and smoothed rocky banks of dry, winding river beds with many potholes and cracks, burrows of birds and rodents	wormwood-cereal and rare halophytic vegetation

Material and Methods

The studies were carried out in July-August 2020 on an area of about 28 hectares. According to the type of soil, surface relief, abundance and species composition of the vegetation cover, 6 types of biotopes were identified, in each of which at least 12 microstacial areas were noted (Table 1). In total, 1443 specimens of spiders were recorded on the soil surface, on the plants, and in various shelters during the research. The species were determined by comparing with the identified material from the collection of the Institute of Zoology of the National Academy of Sciences of Azerbaijan. To classify species according to the degree of abundance in the biotope, an indicator of relative abundance (Engelmann, 1978) was used, expressed in points. Species with an abundance of more than 10% are eudominants (5 points), from 5 to 10% - dominants (4 points), from 2 to 5% - subdominants (3 points), from 1 to 2% - recedents (rare species) (2 points), less than 1% - subrecedents (1 point), in the absence of a species - (0 points).

Comparison of the species composition of the araneofauna in biotopes was carried out using the Chekanovsky index: $I_c = C/(A + B) \cdot 100\%$, where A, B - are the number of species in the compared biotopes, C - is the number of common species. The type of spatial distribution was determined by calculating the aggregation coefficient according to the formula: $\lambda = \sigma / M$, where λ - is the aggregation coefficient, σ - is the standard deviation, and M - is the mean.

Results

In the investigated area of the territory, 68 species of spiders belonging to 14 families were recorded: Agelenidae, Araneidae, Dictynidae, Dysderidae, Filistatidae, Gnaphosidae, Linyphiidae, Lycosidae, Palpimanidae, Philodromidae, Salticidae, Scytodidae, Theridiidae, and Thomisidae. Among the noted spider species, according to their abundance for the entire territory, 4 were identified as dominant species, 11 subdominant species, 13 recedents and 40 subrecedent species (Table 2). As can be seen from the table, no eudominant species were identified for the entire territory.

Table 2. Relative abundance of spider species throughout the study area.

Species	Number		Species	Number	
	N	% *		N	% *
Enoplognatha macrochelis	115	7.96	*Thanatus kitabensis*	12	0.83
Steatoda paykulliana	112	7.76	*Berinda amabilis*	11	0.76
Bassaniodes loeffleri	85	5.89	*Nomisia conigera*	11	0.76
Kochiura aulica	80	5.54	*Argiope lobata*	10	0.69
Pardosa luctinosa	67	4.64	*Thomisus onustus*	9	0.62
Enoplognatha quadripunctata	66	4.57	*Haplodrassus dalmatensis*	8	0.55
Agelena labyrinthica	64	4.43	*Pardosa italica*	8	0.55
Arctosa leopardus	54	3.74	*Pardosa proxima*	8	0.55
Agyneta mesasiatica	53	3.67	*Aelurillus concolor*	8	0.55
Tenuiphantes tenuis	38	2.63	*Xysticus kochi*	8	0.55
Simitidion simile	37	2.56	*Lathys stigmatisata*	7	0.48
Mangora acalypha	34	2.35	*Ozyptila tricoloripes*	7	0.48
Dysdera azerbajdzhanica	32	2,21	*Philaeus chrysops*	7	0.48
Prinerigone vagans	32	2.21	*Scytodes thoracica*	7	0.48
Enoplognatha mediterranea	29	2.00	*Xysticus marmoratus*	7	0.48

Araneus diadematus	27	1.87	*Lycosa praegrandis*	7	0.48
Haplodrassus signifer	26	1.80	*Filistata insidiatrix*	6	0.41
Cyrba algerina	25	1.73	*Agyneta fuscipalpa*	6	0.41
Latrodectus tredecimguttatus	25	1.73	*Menemerus semilimbatus*	6	0.41
Trachyzelotes jaxartensis	21	1.45	*Pellenes geniculatus*	6	0.41
Drassyllus crimeaensis	20	1.38	*Argenna patula*	5	0.34
Nuctenea umbratica	19	1.31	*Pardosa paracolchica*	5	0.34
Drassodes lapidosus	18	1.24	*Steatoda dahli*	5	0.34
Oedothorax apicatus	18	1.24	*Emblyna annulipes*	4	0.27
Agalenatea redii	17	1.17	*Alopecosa cursor*	4	0.27
Erigone dentipalpis	17	1.17	*Trochosa ruricola*	3	0.20
Phlegra bresnieri	17	1.17	*Rhysodromus fallax*	3	0.20
Dysderella caspica	16	1.10	*Steatoda triangulosa*	3	0.20
Nomisia ripariensis	14	0.97	*Xysticus tristrami*	3	0.20
Thanatus imbecillus	14	0.97	*Drassodes pubescens*	2	0.13
Thanatus vulgaris	14	0.97	*Runcinia grammica*	2	0.13
Drassyllus praeficus	12	0.83	*Berlandina apsheronica*	1	0.06
Nomisia aussereri	12	0.83	*Civizelotes caucasius*	1	0.06
Palpimanus cf. *sogdianus*	12	0.83	*Lycosa singoriensis*	1	0.06

* 5-10% = dominants; 2-5% = subdominants; 1-2% = recedents; less than 1% = sub-recedents.

To determine the distribution of spiders over biotopes, only dominant, subdominant, and recedent species were taken into account (Table 3). The distribution of species by biotopes was taken into account on a 5-point scale.

Table 3. Abundance of spider species in different biotopes (in points) and spatial distribution aggregation coefficient (K_A).

Species	Biotope						K_A
	I	II	III	IV	V	VI	
Dysdera azerbajdzhanica	4	2	0	3	3	0	1.11
Agelena labyrinthica	3	2	0	4	5	3	0.95
Araneus diadematus	2	1	0	3	3	4	0.92
Simitidion simile	3	4	0	4	0	3	0.86
Latrodectus tredecimguttatus	3	3	3	0	3	2	0.79
Enoplognatha quadripunctata	3	4	3	3	4	4	0.72
Enoplognatha mediterranea	3	4	1	2	2	3	0.71
Drassodes lapidosus	0	3	3	3	3	1	0.70
Oedothorax apicatus	2	1	4	3	1	1	0.70
Enoplognatha macrochelis	5	4	2	4	5	4	0.69
Kochiura aulica	4	4	4	5	2	3	0.69
Phlegra bresnieri	0	2	3	2	3	1	0.68
Pardosa luctinosa	3	4	3	3	4	4	0.67
Arctosa leopardus	3	4	0	3	4	4	0.65
Agalenatea redii	2	2	1	2	1	3	0.64
Dysderella caspica	3	1	1	2	1	3	0.61
Trachyzelotes jaxartensis	3	2	0	3	2	2	0.56
Drassyllus crimeaensis	2	2	3	3	0	2	0.55
Nuctenea umbratica	2	1	3	3	2	1	0.54

Haplodrassus signifer	2	2	3	1	3	3	0.49
Tenuiphantes tenuis	3	3	3	3	4	3	0.45
Erigone dentipalpis	3	2	3	2	1	1	0.41
Cyrba algerina	2	2	3	2	3	3	0.41
Bassaniodes loeffleri	4	4	5	3	3	4	0.41
Steatoda paykulliana	4	4	4	4	5	5	0.40
Agyneta mesasiatica	3	2	4	4	4	3	0.35
Mangora acalypha	2	3	4	3	3	3	0.29
Prinerigone vagans	3	3	3	3	3	2	0.22

Note. 5 points = eudominants; 4 points = dominants; 3 points = subdominants; 2 points = recedents; 1 point = subrecedents; 0 = no species.

The structure of biotopes presented in the diagram (Fig. 1), is built according to the numerical dominance of spider species, demonstrates the uneven distribution of all groups of dominance, which is probably associated with the different representation of microstations in biotopes. The similarity of the species composition (Ic) in the compared pairs of biotopes was in the range of 50-58%.

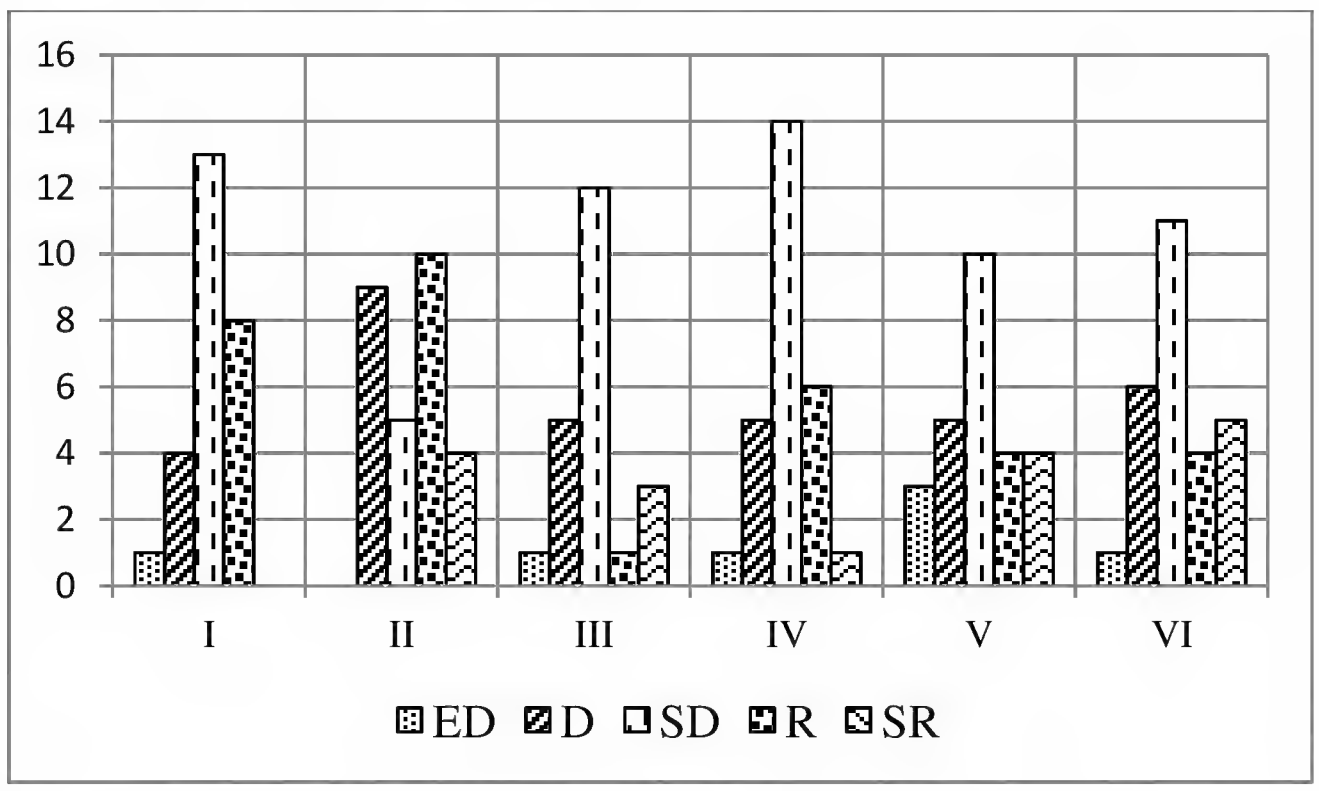


Fig. 1. The structure of biotopes by the abundance of spiders of different dominant groups in them. ED = eudominants; D = dominants; SD = subdominants; R = recedents; SR = subrecedents.

The following spider species were eudominants in biotopes: *Enoplognatha macrochelis* (I), *Bassaniodes loeffleri* (III), *Kochiura aulica* (IV), *Agelena labyrinthica* (V), *Enoplognatha macrochelis* (V), *Steatoda paykulliana* (V, VI). The dominant species in most biotopes were *Dysdera azerbajdzhanica*, *Steatoda paykulliana*, *Pardosa luctinosa*, *Arctosa leopardus*, *Agyneta mesasiatica*, *Kochiura aulica*, and *Bassaniodes loeffleri*.

The identified dominant and subdominant spider species always occupy areas in biotopes with biotopic conditions typical for them. Their localization in most cases is tied to various natural and artificial soil coverings (stones, rocks, random objects of anthropogenic origin), shady areas formed by clusters of rocks and plant formations. Consequently, the degree of species abundance in each of the biotopes largely depends on the spectrum of microstations represented in them, creating a wide choice of microbiotic conditions.

Conclusion

The study of the spatial distribution of spiders showed the presence of a certain selectivity in most of them when choosing habitats. The lowest species diversity is characterized by a biotope with a loamy type of soil interspersed with sandy areas with spaces (takyrs) practically devoid of stones; burrows of small rodents with rare ephemeral and halophytic vegetation are noted from shelters. The greatest diversity of spiders is noted in biotopes with gray-soil type of soils, a dry steppe zone, a hilly valley cut by ravines with focal accumulations of stones and rocky outcrops of remnant rocks, xerophytic herbaceous, shrub and rare woody vegetation. At the same time, the confinement of spiders to certain biotopes is determined by the presence of microbiotopes here, with a certain type and structure of soil, surface relief and the nature and area of vegetation, the degree of illumination and shading of areas of the territory. Three of the identified dominant species are characteristic of all types of biotopes and, therefore, their distribution can be extrapolated to neighbouring unexplored areas.

Acknowledgments

The author express his sincere gratitude to his colleagues at work for their help in determining the material and for valuable advice and comments made during the work.

References

Alieva, T.V. 2010a. To the study of the fauna of spiders (Arachnida: Aranei) of the Gobustan reserve of Azerbaijan. *Kavkazsk. entomol. bul.*, 6(2): 133-142. (In Russian).

Alieva, T.V. 2010b. History and perspectives of the study of the spider (Arachnida: Araneae) fauna of Gobustan. *AMEA aspirantlarının elmi konfrasının materialları.* Baku: 219-224. (In Russian).

Bonn, A. & Kleinwachter, M. 1999. Microhabitat distribution of spider and ground beetle assemblages (Araneae, Carabidae) on frequently inundated river banks of the River Elbe. *Z. Okol. Natursch.*, 8: 109-123.

Budagov, B.A. & Mikailov, A.A. 1985. *Development and formation of landscapes of the South-East Caucasus in connection with the latest tectonics*. Baku: Elm: 176 pp. (In Russian).

Dunin, P.M. 1989. Fauna and altitudinal distribution of spiders (Arachnida, Aranei) in the Azerbaijani part of the southern macroslope of the Greater Caucasus. *In: Fauna and ecology of spiders and scorpions: an arachnological collection. Nauka.* Moscow: 31-39. (In Russian).

Engelmann, H.D. 1978. Zur Dominanz klassifizierung von Bodenarthropoden. *Pedobiologia*, 18: 378-380.

Gryuntal, S.Yu. 2008. *Organization of communities of ground beetles (Coleoptera, Carabidae) of forest biogeocenoses of the East European (Russian) Plain.* Moscow: Halley-Print, 484 pp. (In Russian).

Kassandrova, L.I. 1970. Distribution of ground beetles (Coleoptera, Carabidae) in orchards. *Zoology journal*, 49(10): 1515-1525. (In Russian).

Matalin, A.V. 1997. Features of spatio-temporal differentiation of ground beetle species (Coleoptera, Carabidae) in the steppe zone. *Zoology journal*, 76(9): 1035-1045. (In Russian).

Nuruyeva, T.V. & Huseynov E.F. 2011. To the study of the spider fauna of the coastal zone of the Caspian Sea within Gobustan. *Zoologiya institutunun eserleri*, 29: 448-455. (In Russian).

Omelko, M.M. 2010. *Biotopic and altitudinal-belt distribution of stray herpetobionot spiders (Arachnida, Aranei) in southern Primorye on the example of Mount Sestra. Readings in memory of Alexei Ivanovich Kurentsov*. Issue 21. Vladivostok: Dalnauka: 82-90. (In Russian).

Sharova, I.Kh. & Kiselev, I.E. 1999. *Dynamics of the structure of the population of ground beetles (Coleoptera, Carabidae) in the urbanized landscapes of the city of Saransk. Saransk: Publishing house of Mordovs*. GPI, 213 pp. (In Russian).

Simonov, P.S. 2017. *Altitude distribution of orb-web spiders (Aranei: Araneidae) on the Livadia ridge (South Primorye). Readings in memory of Alexei Ivanovich Kurentsov*. Issue 28. Vladivostok: FSC Biodiversity FEB RAS: 35-45. (In Russian).

Serket (2021) vol. 17(4): 370-393.

Faunal distribution of spiders of the families Titanoecidae, Trachelidae, Trochanteriidae, Uloboridae and Zodariidae (Arachnida: Araneae) in India

Garima Singh [1] & Rajendra Singh [2*]

[1] Department of Zoology, University of Rajasthan, Jaipur, Rajasthan, India

[2] Department of Zoology, Deendayal Upadhyay University of Gorakhpur, U.P., India

[*] Corresponding author e-mail address: rsinghpu@gmail.com

Abstract

The present article deals with the faunal diversity of five families of araeneomorph spiders, viz. Titanoecidae, Trachelidae, Trochanteriidae, Uloboridae, and Zodariidae (Arachnida: Araneae) in different Indian states and union territories. None of the spider species of these families is recorded from Bihar, Daman & Diu and Dadar & Nagar Haveli, Delhi, Jharkhand, Manipur, Nagaland, Punjab, and Telangana. Among these, the largest family is Zodariidae which is represented by 32 species belonging to 12 genera out of which majority (29 species) are endemic followed by Uloboridae which comprises 30 species placed in 5 genera. Other families are very poorly represented in India. Only 5 species of a single genus, *Plator* Simon, 1880 are recorded in Trochanteriidae; 8 species in 3 genera in Trachelidae and 10 species in 3 genera in Titanoecidae are recorded. Only two species, *Uloborus danolius* Tikader, 1969 and *Zosis geniculata* (Olivier, 1789) are distributed in 15 and 14 states and union territories of India, respectively. Maximum number of spider species of these families were recorded in Maharashtra (28 species) followed by Kerala (23 species), Tamil Nadu (19), Gujarat (16 species), West Bengal (12 species), Karnataka (11 species), Uttarakhand (9 species) and lesser number in other states and union territories. Out of 84 species recorded of these 5 families, 67 species are endemic and 3 species seem to be erroneous records.

Keywords: Spiders, Titanoecidae, Trachelidae, Trochanteriidae, Uloboridae, Zodariidae, Faunal Diversity, India.

Introduction

Spiders (Arachnida: Araneae) play a very significant role in the ecology by preying and thereby regulating insect populations. Despite the applied values, the spiders have received very little attention regarding their conservation. Only few tarantulas in India are listed in IUCN Red List (Molur *et al.*, 2008). Even though current researches on diversity and distribution of spiders in India, their number is too little as compared to other regions of the world. Out of 49,435 described species under 4,217 genera and 129 families in the world (World Spider Catalog, 2021), only 1867 species belonging to 475 genera in 62 families are known in India (Caleb & Sankaran, 2021). Recently, Sharma *et al.* (2020a, b; 2021), Singh (2021a, b, c), Singh & Singh (2020, 2021), Singh *et al.* (2020a, b, c, d, e, f, g; 2021a, b), Tiwari *et al.* (2021a, b), and Tiwari & Singh (2021) updated the distribution pattern of several families of spiders in India.

The present article deals with the faunal distribution of five families of Araneomorphae spiders, Titanoecidae, Trachelidae, Trochanteriidae, Uloboridae, and Zodariidae in different Indian states and union territories. The amount of knowledge on these families is very inadequate and underrepresented in India and also the available literature are scattered and so far no consolidated account is available regarding their distribution pattern across the country. Therefore, this present work was undertaken to furnish recent information on the distribution pattern of these families in India. Several species reported and described from India appear to be misidentified and the records are erroneously reported as these species are said to be identified by using existing literature without a re-examination of the corresponding types and without consulting any spider taxonomist of the country (Singh & Singh, 2020). Hence, such reports need re-examination. Also, in most of the literature, published in past, several errors crept in their scientific names even in the recent ones because such contents become outdated quickly and, due to their perceived comprehensiveness, researchers sometimes overlook newer sources of data. In addition, researches are continuous on the spider taxonomy with the description of new taxa, their modified status, and the publication of other nomenclatural decisions (Singh *et al.*, 2020c).

Material and Methods

This checklist is prepared on the basis of published literature in surveys, books, journals, theses and World Spider Catalog (WSC) up to 30 April, 2021. In the present checklist, attempts have been made to correct such errors in the scientific names of the spiders. Only those synonymies were referred that were reported in India. For other synonymies, World Spider Catalog (2021) may be consulted. All the endemic species are marked with (*). Also, those spiders not identified up to specific level, were omitted if some species of that genus were recorded under that genus in that state. However, those were mentioned if either no species of that genus was reported in that state. Seemingly erroneous records are marked with (♦). If the spider species is not endemic, its elsewhere distribution is also provided.

Results and Discussion

A. Faunal Diversity of the Family Titanoecidae Lehtinen, 1967

Titanoecidae Lehtinen, 1967, commonly called as rock weavers, is a very small family of araneomorph spiders widely distributed in the New World and Eurasia with five genera and 55 species globally (World Spider Catalog, 2021). These are mostly dark-

coloured cribellate spiders and construct wooly silk webs which may be attached to the substrate and can include sheet-like components. All these spiders have a divided cribellum, a complex dorso-apical apophysis on the tibia of male palpus, a tegular process near the base of the embolus and a median apophysis (a flexible projection attached to the middle of the tegulum) that is located baso-laterally on the tegulum (Lehtinen, 1967; Griswold *et al.*, 2005). Though, the members of Titanoecidae do not display social behaviours (e.g. building and maintaining communal nests, cooperative hunting and parental care of the spiderlings), the members of one Neotropical genus *Goeldia* Keyserling, 1891 were observed to display subsocial behaviour, inside a cave (Almeida-Silva *et al.*, 2009).

At present, Titanoecidae includes 3 genera and 10 species in India, out of which 7 species are endemic. The spider genus *Pandava* Lehtinen, 1967 is currently represented by 8 species in India, out of which 6 are endemic. Two genera, *Anuvinda* Lehtinen, 1967 and *Titanoeca* Thorell, 1870 are represented by single species. In India, these spiders are recorded only in 8 Indian states and only one union territory (Andaman & Nicobar Islands) (Fig. 1) as mentioned below.

Fig. 1. Distribution of spiders belonging to different families in Indian states and union territories (Ti = Titanoecidae, Tra = Trachelidae, Tro = Trochanteriidae, U = Uloboridae, Z = Zodariidae).

1. *Anuvinda escheri* (Reimoser, 1934)
- Tamil Nadu (Karthikeyani *et al.*, 2017)

Elsewhere: China, Laos, Thailand.

2. *Pandava andhraca* (Patel & Reddy, 1990) *
syn. *Amaurobius andhracus* Patel & Reddy, 1990)
- Andhra Pradesh (Patel & Reddy, 1990)

3. *Pandava aruni* Bodkhe, Uniyal, Kamble, Manthen, Santape & Chikhale, 2017 *
- Maharashtra (Bodkhe *et al.*, 2017)

4. *Pandava ganesha* Almeida-Silva, Griswold & Brescovit, 2010 *
- Tamil Nadu (Almeida-Silva *et al.*, 2010)

5. *Pandava ganga* Almeida-Silva, Griswold & Brescovit, 2010 *
- Karnataka (Almeida-Silva *et al.*, 2010)
- Maharashtra (Almeida-Silva *et al.*, 2010)

6. *Pandava kama* Almeida-Silva, Griswold & Brescovit, 2010 *
- Maharashtra (Almeida-Silva *et al.*, 2010)

7. *Pandava laminata* (Thorell, 1878)
syn. *Phaeocedus nicobarensis* Tikader, 1977
- Andaman & Nicobar Islands (Tikader, 1977, 1982)
- Gujarat (Solanki *et al.*, 2017; Yadav *et al.*, 2017)
- Maharashtra (Nerlekar *et al.*, 2016)
- Odisha (Gravely, 1921; Mohapatra *et al.*, 2014; Chetry & Moran, 2019)

Elsewhere: Britain, China, France, Germany, Hungary, Kenya, Madagascar, Micronesia, Netherlands, New Guinea, Poland, Sri Lanka, Tanzania.

8. *Pandava nathabhaii* (Patel & Patel, 1975) *
syn. *Amaurobius nathabhaii* Patel & Patel, 1975)
- Gujarat (Patel & Patel, 1975; Patel & Pillai, 1988; Yadav *et al.*, 2017)

9. *Pandava shiva* Almeida-Silva, Griswold & Brescovit, 2010
- Rajasthan (Almeida-Silva *et al.*, 2010)

Elsewhere: Pakistan.

10. *Pandava* sp.
- Gujarat (Solanki *et al.*, 2020)

11. *Titanoeca sharmai* (Bastawade, 2008) *
syn. *Amaurbius sharmai* Bastawade, 2008)
- Himachal Pradesh (Bastawade, 2008)

B. Faunal Diversity of the Family Trachelidae Simon, 1897

Trachelidae is a recently elevated small family of mostly indoor spiders consisting of 253 species in 20 genera worldwide except in Australia and New Zealand (Ramírez, 2014; World Spider Catalog, 2021). They are ground sac spiders mostly wandering in habit and never construct webs. The type genus, *Trachelas* L. Koch, 1872 is the most speciose genus of the family having 90 species. These spiders are characterized by having a strong reduction in the number of normal leg spines, the presence (mostly in males) of blunt ventral legs cusps on the last three apical segments of the anterior legs (Platnick & Shadab, 1974), and the presence of 4-5 cylindrical gland spigots in two rows in the female posterior median spinnerets (Bosselaers *et al.*, 2009). The trachelid spiders usually

prefer ground habitat, in loose bark of trees, in rolled leaves, or under stones (Dondale & Redner, 1982).

At present, Trachelidae is represented by only 8 species under 3 genera in India, out of which 3 species are endemic, and one species, *Utivarachna fukasawana* Kishida, 1940 seems to be misidentified/reported, from Kerala. In India, these spiders are recorded only in 9 Indian states and only one union territory (Ladakh) (Fig. 1) as listed below.

1. *Orthobula impressa* Simon, 1897

- Maharashtra (Bodkhe & Manthen, 2014)

Elsewhere: Sri Lanka, Reunion, Seychelles.

2. *Trachelas chamoli* Quasin, Siliwal & Uniyal, 2018 *

- Uttarakhand (Quasin *et al.*, 2018)

3. *Trachelas costatus* O. Pickard-Cambridge, 1885

syn. *Trachelas costata* O. Pickard-Cambridge, 1885

- Jammu & Kashmir (Caporiacco, 1935; Marusik *et al.*, 2018)
- Ladakh (O. Pickard-Cambridge, 1885)

Elsewhere: Pakistan.

4. *Trachelas himalayensis* Biswas, 1993 *

- Uttar Pradesh (Hore & Uniyal, 2008a, b)
- West Bengal (Biswas, 1992)

5. *Trachelas oreophilus* Simon, 1906

syn. *Trachelas oriophila* Simon, 1906

- Maharashtra (More & Sawant, 2013)
- Tamil Nadu (Simon, 1906a; Majumder & Tikader, 1991; Karthikeyani *et al.*, 2017)

Elsewhere: Sri Lanka.

6. *Trachelas* sp.

- Gujarat (Solanki, 2016)
- Uttarakhand (Uniyal *et al.*, 2011)

7. *Utivarachna fronto* (Simon, 1906) *

syn. *Trachelas fronto* Simon, 1906

- Maharashtra (Meshram, 2011)
- Tamil Nadu (Simon, 1906a; Majumder & Tikader, 1991; Karthikeyani *et al.*, 2017)

8. *Utivarachna fukasawana* Kishida, 1940 ♦

- Kerala (Asalatha *et al.*, 2017)

Elsewhere: Borneo.

9. *Utivarachna* sp.

- Kerala (Abhilash & Kumar, 2018)

C. Faunal Diversity of the Family Trochanteriidae Karsch, 1879

Trochanteriidae is a small and little known family of spiders having 171 species in 21 genera (World Spider Catalog, 2021). Most of the species are endemic to Australia. These spiders are dull brown with highly flattened carapace, with the eyes occupying most of the carapace width and difficult to locate as they are cryptic in nature living beneath the tree bark or rocks. The family name is derived from 'trochanter' that refers to the second segment of the leg or palp between coxa and femur. The spiders of this family

have a highly elongated trochanter of leg IV, which is at least 1.5 times longer than that of leg III, a fairly peculiar character (Platnick, 2002).

In India, only 5 species of a single genus *Plator* Simon, 1880 are known, out of which 4 species are endemic. One species, *Plator pandeae* Tikader, 1969 was also recorded in China (Hu & Li, 1987). In India, these spiders are recorded only in 5 Indian states and only one union territory (Jammu & Kashmir) (Fig. 1) as listed below.

1. *Plator himalayaensis* Tikader & Gajbe, 1976 *

- Uttarakhand (Tikader & Gajbe, 1976a; Sankaran *et al.*, 2020a)

2. *Plator indicus* Simon, 1897 *

syn. *Plator ixodinus* Pocock, 1899

- Himachal Pradesh (Pocock, 1900)
- Karnataka (Tabasum *et al.*, 2018)
- Maharashtra (Simon, 1897; Pocock, 1900)
- Uttarakhand (Pocock, 1899, 1900; Uniyal *et al.*, 2011)
- West Bengal (Talukdar, 2015)

3. *Plator kashmirensis* Tikader & Gajbe, 1973 *

- Jammu & Kashmir (Tikader & Gajbe, 1973; Sankaran *et al.*, 2020a)

4. *Plator pandeae* Tikader, 1969

- Himachal Pradesh (Sankaran *et al.*, 2020a)
- Uttarakhand (Tikader, 1969a)

Elsewhere: China.

5. *Plator solanensis* Tikader & Gajbe, 1976 *

- Himachal Pradesh (Tikader & Gajbe, 1976b; Sankaran *et al.*, 2020a)

D. Faunal Diversity of the Family Uloboridae Thorell, 1869

The spiders of the family Uloboridae Thorell, 1869 are commonly known as the hackled-band orb-weavers as the spiral portion of the capturing web (in the form of orbs or portions of orbs) is spun by an unusual type of wooly silk thread (cribellate) known as hackled band. These spiders sometimes live in group with individual webs loosely connected. They lack poison glands and encase their prey thoroughly in silk covering it in regurgitated digestive juice, and then ingest the liquified body. They are characterized by having four (arranged in one row), six or eight eyes (arranged in two rows of four) and three tarsal claws; a dorsally compressed, curved metatarsus IV possessing a uniseriate calamistrum (often absent in males); rows of long trichobothria on femora. When eyes are only four, they are accompanied by increased visual angles, optical material investment, and potential visual acuity of the retained eyes (Opell, 1988).

The Uloboridae is a small family and is represented by only 287 species described under 19 genera worldwide (World Spider Catalog, 2021). In India, only 30 species placed in 5 genera are known, out of which 22 species are endemic. All these species are recorded in 21 Indian states except Arunchal Pradesh, Bihar, Jharkhand, Manipur, Nagaland, Punjab, and Telangana; and in 4 union territories (Andaman & Nicobar Islands, Jammu & Kashmir, Lakshadweep, and Puducherry) (Fig. 1). One species, *Miagrammopes thwaitesi* O. Pickard-Cambridge, 1870 was said to be recorded from India (Siliwal *et al.*, 2005; Keswani *et al.*, 2012; Caleb & Sankaran, 2020; World Spider Catalog, 2021) but we could not find its locality in India, neither in original description (of female) of O. Picard-Cambridge (1870) nor in Lehtinen (1967) who simply drawn the figure of male without any taxonomic remark. Also, Logunov (2018) remarked on this

species “the generotype - *M. thwaitesii* from Sri Lanka - has never been re-examined and re-described, and thus is still known from the original description only (O. Pickard-Cambridge, 1870); the whereabouts of its holotype female, which should have been deposited in the Oxford University Museum of Natural History, is also unknown.” Hence, its record in India is doubtful. Another species, *Uloborus diversus* Marx, 1898 seems to be misidentified/reported, from Karnataka. The detail distribution pattern of these spiders in India is listed below.

1. *Hyptiotes affinis* Bösenberg & Strand, 1906
- Kerala (Chatterjee *et al.*, 2018)

Elsewhere: China, Korea, Taiwan, Japan.

2. *Hyptiotes himalayensis* Tikader, 1981 *
- Himachal Pradesh (Tikader, 1981b)

3. *Hyptiotes indicus* Simon, 1905 *
- Kerala (Simon, 1905)

4. *Hyptiotes* sp.
- Tamil Nadu (Kapoor, 2008)
- Uttarakhand (Uniyal *et al.*, 2011)

5. *Miagrammopes albomaculatus* Thorell, 1891 *
- Andaman & Nicobar Islands (Thorell, 1891)
- Maharashtra (Rithe, 2012)

6. *Miagrammopes apostrophus* Sen, Saha & Raychaudhuri, 2013 *
- West Bengal (Sen *et al.*, 2013, 2015)

7. *Miagrammopes extensus* Simon, 1889 *
- Karnataka (Bhat *et al.*, 2013)
- Kerala (Malamel & Samson, 2014; Jose *et al.*, 2018; Adarsh & Nameer, 2016)
- Uttarakhand (Simon, 1889)

8. *Miagrammopes gravelyi* Tikader, 1971 *
- Kerala (Biswas & Biswas, 2007)
- Mizoram (Biswas & Biswas, 2007)
- Uttar Pradesh (Uniyal & Hore, 2009)

9. *Miagrammopes indicus* Tikader, 1971 *
- Maharashtra (More & Sawant, 2013)
- Uttar Pradesh (Uniyal & Hore, 2009)

10. *Miagrammopes kirkeensis* Tikader, 1971 *
- Maharashtra (Tikader, 1971; Saha *et al.*, 2016)
- Meghalaya (Roy *et al.*, 2017)
- West Bengal (Raychaudhuri *et al.*, 2016; Saha *et al.*, 2016)

11. *Miagrammopes poonaensis* Tikader, 1971 *
- Maharashtra (Tikader, 1971; Rithe, 2012)

12. *Miagrammopes satpudaensis* Rajoria, 2015 *
- Maharashtra (Rajoria, 2015)

13. *Miagrammopes sexpunctatus* Simon, 1906 *
- Himalayan plateaus (Simon, 1906a)

- Kerala (Joseph *et al.*, 2017)

14. ***Miagrammopes sutherlandi*** Tikader, 1971 *
- West Bengal (Tikader, 1971)

15. ***Miagrammopes thwaitesi*** O. Pickard-Cambridge, 1870
- India (Keswani *et al.*, 2012; Caleb & Sankaran, 2020)

Elsewhere: Sri Lanka.

16. ***Miagrammopes*** sp.
- Goa (Pandit & Dharwadkar, 2020)
- Gujarat (Sunil Jose *et al.*, 2008; Yadav *et al.*, 2017; Solanki *et al.*, 2020)
- Karnataka (Abhijith, 2019)
- Kerala (Sudhikumar *et al.*, 2005; Sunil Jose *et al.*, 2008)
- Tamil Nadu (Kapoor, 2008)
- Uttarakhand (Uniyal *et al.*, 2011; Gupta & Siliwal, 2012)

17. ***Philoponella hilaris*** (Simon, 1906) *

syn. *Uloborus hilaris* Simon, 1906
- Tamil Nadu (Simon, 1906b; Sherriffs, 1928)

18. ***Philoponella*** sp.
- Gujarat (Yadav *et al.*, 2017; Thumar, 2019)

19. ***Uloborus albescens*** O. Pickard-Cambridge, 1885
- Jammu & Kashmir (O. Pickard-Cambridge, 1885; Caporiacco, 1935)

Elsewhere: Pakistan.

20. ***Uloborus bigibbosus*** Simon, 1905 *
- Puducherry (Simon, 1905)
- Tamil Nadu (Sherriffs, 1927)

21. ***Uloborus danolius*** Tikader, 1969 *
- Andaman & Nicobar Islands (Tikader, 1977; Gajbe UA, 1992, 2004, 2007; Gajbe PU, 2004)
- Andhra Pradesh (Palem *et al.*, 2016)
- Assam (Chetia & Kalita, 2012; Singh *et al.*, 2012, 2013)
- Chhattisgarh (Gajbe & Sharma, 1994; Kujur & Ekka, 2016)
- Gujarat (Patel & Vyas, 2001; Siliwal *et al.*, 2003a, b; Parasharya & Pathan, 2013; Solanki & Kumar, 2015; Yadav *et al.*, 2017; Solanki *et al.*, 2020)
- Haryana (Malik & Goyal, 2017)
- Karnataka (Nautiyal *et al.*, 2017; Mubeen & Basavarajappa, 2018)
- Kerala (Patel, 2003a; Sebastian *et al.*, 2005b; Sunil Jose *et al.*, 2008; Adarsh & Nameer, 2016)
- Madhya Pradesh (Gajbe UA, 1992, 2004, 2007; Gajbe P., 2003a, b; Dhali *et al.*, 2017)
- Maharashtra (Tikader, 1969b, 1977; Tikader & Biswas, 1981; Biswas & Biswas, 1992; Gajbe UA, 1992, 2004, 2007; Gajbe PU, 2004; Majumder, 2004, 2005; Meshram, 2011; Sawane, 2016; Lanka *et al.*, 2017)
- Rajasthan (Lawania & Trigunayat, 2015)
- Tamil Nadu (Siliwal *et al.*, 2008; Umarani & Umamaheswari, 2013)
- Uttar Pradesh (Hore & Uniyal, 2008a, b; Uniyal & Hore, 2009; Lawania & Mathur, 2014a, b, c, d)
- Uttarakhand (Biswas & Biswas, 2010; Gupta & Siliwal, 2012)

- West Bengal (Tikader, 1977; Tikader & Biswas, 1981; Biswas & Biswas, 1992; Gajbe UA, 1992, 2004, 2007; Gajbe PU, 2004; Majumder, 2004, 2005, 2007)

22. *Uloborus diversus* Marx, 1898 ♦

- Karnataka (Nijagal *et al.*, 2020)

Elsewhere: Mexico, USA.

23. *Uloborus ferokus* Bradoo, 1979 *

- Kerala (Bradoo, 1979; Asalatha *et al.*, 2017)

24. *Uloborus filifaciens* Hingston, 1927 *

- Andaman & Nicobar Islands (Hingston, 1927)

25. *Uloborus furunculus* Simon, 1906 *

- Maharashtra (Simon, 1906b; Sherriffs, 1928)

26. *Uloborus glomosus* (Walckenaer, 1841) ♦

- Karnataka (Nijagal *et al.*, 2020)

Elsewhere: USA, Canada, Mexico.

27. *Uloborus jabalpurensis* Bhandari & Gajbe, 2001 *

- Chhattisgarh (Ekka & Kujur, 2015)
- Madhya Pradesh (Gajbe P., 2003a, b; Gajbe UA, 2004; Patil, 2012)
- Maharashtra (Rithe, 2012; Maheshwari *et al.*, 2019)
- Tamil Nadu (Karthikeyani, 2013)

28. *Uloborus khasiensis* Tikader, 1969 *

- Andaman & Nicobar Islands (Tikader, 1977)
- Assam (Tikader, 1969b; Saha *et al.*, 2016; Roy *et al.*, 2017)
- Gujarat (Siliwal *et al.*, 2003b; Solanki & Kumar, 2015; Solanki, 2016; Suthar *et al.*, 2017; Yadav *et al.*, 2017)
- Kerala (Patel, 2003a; Rajeevan *et al.*, 2019)
- Madhya Pradesh (Gajbe P, 2003b; Gajbe UA, 2007)
- Maharashtra (Rithe, 2012; More & Sawant, 2013; More, 2015)
- Meghalaya (Gajbe UA, 2007; Saha *et al.*, 2016; Roy *et al.*, 2017)
- West Bengal (Raychaudhuri *et al.*, 2016; Saha *et al.*, 2016; Roy *et al.*, 2017)

29. *Uloborus krishnae* Tikader, 1970 *

- Gujarat (Parmar & Patel, 2015; Parmar *et al.*, 2015; Yadav *et al.*, 2017; Thumar, 2019; Solanki *et al.*, 2020)
- Haryana (Malik & Goyal, 2017)
- Karnataka (Nautiyal *et al.*, 2017; Mubeen & Basavarajappa, 2018; Nijagal *et al.*, 2020)
- Kerala (Sudhikumar *et al.*, 2005; Sunil Jose *et al.*, 2008; Mathew *et al.*, 2014; Asalatha *et al.*, 2017; Jose *et al.*, 2018; Rajeevan *et al.*, 2019)
- Maharashtra (More & Sawant, 2013; Nerlekar *et al.*, 2016)
- Andaman & Nicobar Islands (Tikader, 1977)
- Sikkim (Tikader, 1970, 1977; Biswas & Biswas, 1992)
- Uttarakhand (Uniyal *et al.*, 2011; Pooja *et al.*, 2019)
- West Bengal (Biswas & Biswas, 1992)

30. *Uloborus modestus* Thorell, 1891 *

- Andaman & Nicobar Islands (Thorell, 1891; Sherriffs, 1928)

- Maharashtra (Rithe, 2012)

31. ***Uloborus plumipes*** Lucas, 1846

- Gujarat (Parmar, 2013; Parmar *et al.*, 2015; Prajapati *et al.*, 2016a; Prajapati *et al.*, 2018; Thumar, 2019; Yadav, 2019)
- Haryana (Malik & Goyal, 2017)
- Karnataka (Nijagal *et al.*, 2020)
- Maharashtra (Rithe, 2012)
- Rajasthan (Lawania & Mathur, 2017a, b)

Elsewhere: Africa, Argentina, Europe, Iran, Japan, Pakistan, Philippines, Yemen.

32. ***Uloborus walckenaerius*** Latreille, 1806

- Madhya Pradesh (Keswani, 2014)
- Maharashtra (Keswani & Vankhede, 2014)

Elsewhere: Caucasus, China, Europe, Iran, Iraq, Japan, Korea, Madeira, Russia, Turkey.

33. ***Uloborus*** sp.

- Andhra Pradesh (Palem *et al.*, 2016)
- Assam (Das *et al.*, 2015)
- Goa (Pandit & Pai, 2017; Pandit & Dharwadkar, 2020)
- Gujarat (Patel, 2003b; Siliwal *et al.*, 2003b; Parasharya & Pathan, 2013; Bhatt, 2014; Parmar *et al.*, 2015; Solanki *et al.*, 2020)
- Karnataka (Abhijith, 2019; Kokilamani *et al.*, 2019)
- Kerala (Patel, 2003a; Sebastian *et al.*, 2005a, b; Abhilash & Kumar, 2018)
- Madhya Pradesh (Sharma & Sharma, 2015)
- Maharashtra (Nerlekar *et al.*, 2016)
- Odisha (Choudhury *et al.*, 2019)
- Rajasthan ((Chauhan *et al.*, 2009; Kaur *et al.*, 2014; Kumari *et al.*, 2017; Lawania & Mathur, 2017a; Malhotra *et al.*, 2019)
- Sikkim (Tikader, 1961)
- Tamil Nadu (Kapoor, 2008; Caleb, 2020a)
- Uttar Pradesh (Tandon & Lal, 1983; Hore & Uniyal, 2008a, b; Uniyal & Hore, 2009)
- Uttarakhand (Uniyal *et al.*, 2011; Gupta & Siliwal, 2012)
- West Bengal (Talukdar & Majumder, 2008; Ghosh *et al.*, 2018)

34. ***Zosis geniculata*** (Olivier, 1789)

syn. *Uloborus geniculatus* (Olivier, 1789)

- Assam (Das *et al.*, 2015; Ahmed, 2018)
- Gujarat (Solanki, 2016; Yadav *et al.*, 2017; Thumar, 2019; Yadav, 2019; Solanki *et al.*, 2020)
- Haryana (Malik & Goyal, 2017)
- Karnataka (Sherriffs, 1927; Nalini Bai & Ravindranatha, 2012; Nijagal *et al.*, 2020)
- Kerala (Sudhikumar *et al.*, 2005; Sunil Jose *et al.*, 2008; Jose *et al.*, 2018; Rajeevan *et al.*, 2019)
- Lakshadweep (Pocock, 1904)
- Maharashtra (Bhuvad *et al.*, 2011; Rithe, 2012; More & Sawant, 2013; Keswani & Vankhede, 2014; Nerlekar *et al.*, 2016)
- Odisha (Gravely, 1921; Biswas, 1987; Choudhury *et al.*, 2019; De & Palita, 2018)
- Puducherry (Leardi in Airaghi, 1901b)
- Rajasthan (Lawania & Mathur, 2017a)

- Tamil Nadu (Sherriffs, 1919, 1927; Sugumaran *et al.*, 2007; Kapoor, 2008)
- Uttar Pradesh (Kumar *et al.*, 2017)
- Uttarakhand (Leardi in Airaghi, 1901a; Quasin & Uniyal, 2010; Uniyal *et al.*, 2011; Pooja *et al.*, 2019; Siddhu *et al.*, 2020)
- West Bengal (Sen *et al.*, 2015)

Elsewhere: Australia, Brazil, Caribbean, China, Hawaii, Indonesia, Japan, Korea, Macaronesia, Philippines, Seychelles, USA, West Africa.

35. ***Zosis*** sp.

- Assam (Chetia & Kalita, 2012)
- Karnataka (Abhijith, 2019)
- Kerala (Mathew *et al.*, 2014)
- Gujarat (Parmar *et al.*, 2015)
- Maharashtra (Sawane, 2016; Lanka *et al.*, 2017)
- Tripura (Dey *et al.*, 2013)

E. Faunal Diversity of the Family Zodariidae Thorell, 1881

The spiders of the family Zodariidae are sometimes called as ant spiders because most of the species live together with ants, prey them (also termites) and also mimic their behaviour and chemical traits. They are small to medium sized, eight-eyed spiders mostly distributed in tropics and subtropics of the world. Most of the species are ground living spiders and hunt during daytime. Some species of this family (e.g. *Lutica* sp.) live in underground silken burrows and capture prey by biting through the burrow walls (Ramírez, 1995). Few species are found on and beneath rocks, where they build retreats covered with sand grains and feed on ants (Jocqué, 1991). In typical zodariids, the spiders have a particular conformation of the spinning field of the anterior lateral spigots and have teeth on the inner side of the leg tarsal claws. The species of *Cryptothele* L. Koch, 1872 cover most of their body with mud and are probably specialized to prey on termites (Ramírez *et al.*, 2014).

The Zodariidae is represented by 1205 species placed in 87 genera globally (World Spider Catalog, 2021). In India, only 32 species belonging to 12 genera are known, out of which majority (29 species) are endemic. All these species are recorded only in 14 Indian states and in single union territory (Puducherry) (Fig. 1). The detail distribution pattern of these spiders in India is listed below.

1. ***Asceua cingulata*** (Simon, 1905) *

syn. *Suffucia cingulata* Simon, 1905

- Kerala (Adarsh & Nameer, 2016; Joseph *et al.*, 2017)
- Maharashtra (More & Sawant, 2013)
- Odisha (Gravely, 1921; Biswas, 1987; Choudhury *et al.*, 2019)
- Puducherry (Simon, 1905)

2. ***Asceua*** sp.

- Gujarat (Parmar *et al.*, 2015; Yadav *et al.*, 2017)
- Odisha (Choudhury *et al.*, 2019)

3. ***Cryptothele collina*** Pocock, 1901*

- Tamil Nadu (Pocock, 1901; Karthikeyani *et al.*, 2017; Caleb & Karthikeyani, 2020)

4. ***Cryptothele sundaica*** Thorell, 1890

- Kerala (Sudhikumar *et al.*, 2008)

Elsewhere: Singapore, Indonesia.

5. ***Cryptothele*** sp.
- Kerala (Adarsh & Nameer, 2015)

6. ***Cydrela escheri*** (Reimoser, 1934) *
syn. *Capheris escheri* Reimoser, 1934
- Tamil Nadu (Reimoser, 1934; Karthikeyani *et al.*, 2017; Caleb & Karthikeyani, 2020)

7. ***Cydrela nitidiceps*** (Simon, 1905) *
syn. *Capheris nitidiceps* Simon, 1905
- Tamil Nadu (Simon, 1905)

8. ***Cydrela stillata*** (Simon, 1905) *
syn. *Capheris stillata* Simon, 1905
- Kerala (Simon, 1905)

9. ***Euryeidon jatashankarae*** Talwar, Majagi, Bodkhe & Kamble, 2018 *
- Madhya Pradesh (Talwar *et al.*, 2018)

10. ***Euryeidon katapagai*** Talwar, Majagi, Bodkhe & Kamble, 2018 *
- Karnataka (Talwar *et al.*, 2018)

11. ***Heliconilla*** sp.
- Maharashtra (Keswani & Vankhede, 2014)

12. ***Hermippus arjuna*** (Gravely, 1921) *
- Kerala (Sankaran *et al.*, 2014)
- Odisha (Gravely, 1921; Biswas, 1987; Panda *et al.*, 2011; Sankaran *et al.*, 2014; Chetry & Moran, 2019)

13. ***Hermippus cruciatus*** Simon, 1905 *
- Gujarat (Sankaran *et al.*, 2014)
- Tamil Nadu (Simon, 1905; Karthikeyani *et al.*, 2017; Caleb & Karthikeyani, 2020)

14. ***Hermippus gavi*** Sankaran, Jobi, Joseph & Sebastian, 2014 *
- Kerala (Sankaran *et al.*, 2014; Joseph *et al.*, 2017)

15. ***Hermippus globosus*** Sankaran, Jobi, Joseph & Sebastian, 2014 *
- Kerala (Sankaran *et al.*, 2014)

16. ***Hermippus inflexus*** Sankaran, Jobi, Joseph & Sebastian, 2014 *
- Kerala (Sankaran *et al.*, 2014)

17. ***Hermippus*** sp.
- Odisha (Panda *et al.*, 2011; Choudhury *et al.*, 2019)
- Uttarakhand (Gupta & Siliwal, 2012)

18. ***Laminion arakuense*** (Patel & Reddy, 1989) *
syn. *Storena arakuensis* Patel & Reddy, 1989
- Andhra Pradesh (Patel & Reddy, 1989; Sankaran *et al.*, 2020b)

19. ***Laminion birenifer*** (Gravely, 1921) *
syn. *Storena birenifer* Gravely, 1921; *Storena tikaderi*, Patel & Reddy, 1989
- Andhra Pradesh (Patel & Reddy, 1989; Sankaran *et al.*, 2020b)
- Odisha (Gravely, 1921; Biswas, 1987; Sankaran *et al.*, 2020b)

20. ***Laminion debasrae*** (Biswas & Biswas, 1992) *
syn. *Storena debasrae* Biswas & Biswas, 1992

- West Bengal (Biswas & Biswas, 1992; Majumder, 2005; Sankaran *et al.*, 2020b)

21. *Laminion gujaratense* (Tikader & Patel, 1975) *
syn. *Storena gujaratensis* Tikader & Patel, 1975; *Suffasia gujaratensis* (Tikader & Patel, 1975)
- Andhra Pradesh (Patel & Reddy, 1989)
- Gujarat (Tikader & Patel, 1975; Patel & Reddy, 1989; Solanki, 2016; Solanki *et al.*, 2018, 2020; Yadav, 2019; Sankaran *et al.*, 2020b)

22. *Mallinella dibangensis* (Biswas & Biswas, 2006) *
syn. *Storena dibangensis* Biswas & Biswas, 2006
- Arunachal Pradesh (Biswas & Biswas, 2006; Sankaran *et al.*, 2020b)

23. *Mallinella indica* (Tikader & Patel, 1975) *
syn. *Storena indica* Tikader & Patel, 1975
- Andhra Pradesh (Patel & Reddy, 1989)
- Gujarat (Tikader & Patel, 1975; Patel & Pillai, 1988; Patel & Reddy, 1989; Parmar, 2013; Yadav *et al.*, 2017; Sankaran *et al.*, 2020b)

24. *Mallinella nilgherina* (Simon, 1906) *
syn. *Storena nilgherina* Simon, 1906
- Tamil Nadu (Simon, 1906a; Dankittipakul *et al.*, 2012; Karthikeyani *et al.*, 2017)

25. *Mallinella redimita* (Simon, 1905)
syn. *Storena redimita* Simon, 1905
- Puducherry (Simon, 1905; Dankittipakul *et al.*, 2012)
- Tamil Nadu (Simon, 1905; Dankittipakul *et al.*, 2012)

Elsewhere: Sri Lanka.

26. *Mallinella* sp.
syn. *Storena* sp. (all *Storena* species described in India were transferred to the genus *Mallinella*)
- Gujarat (Parasharya & Pathan, 2013; Yadav *et al.*, 2017; Parmar, 2020; Solanki *et al.*, 2020)
- Karnataka (Prashanthakumara & Venkateshwarlu, 2017)
- Kerala (Patel, 2003a)
- Maharashtra (Lanka *et al.*, 2017)
- Odisha (Choudhury *et al.*, 2019)

27. *Storenomorpha joyaus* (Tikader, 1970) *
syn. *Homalonychus joyaus* Tikader, 1970; *Homalonichus jayantius* Tikader, 1970
- Sikkim (Tikader, 1970; Sen *et al.*, 2015; Dhali *et al.*, 2017; Sankaran *et al.*, 2020b)
- West Bengal (Majumder & Talukdar, 2013; Sen *et al.*, 2015; Dhali *et al.*, 2017)

28. *Suffasia ala* Sen, Dhali, Saha & Raychaudhuri, 2015 *
- West Bengal (Sen *et al.*, 2015; Dhali *et al.*, 2017)

29. *Suffasia keralaensis* Sudhikumar, Jocqué & Sebastian, 2009 *
- Kerala (Sudhikumar *et al.*, 2009)

30. *Suffasia tigrina* (Simon, 1893) *
- Rajasthan (Patil *et al.*, 2016)
- Tamil Nadu (Simon, 1905; Jocqué, 1991)

31. *Suffasia* sp.

- Odisha (Choudhury *et al.*, 2019)

32. *Tropizodium bengalensis* (Tikader & Patel, 1975) *
syn. *Lutica bengalensis* Tikader & Patel, 1975
- Maharashtra (Tikader, 1981a; More & Sawant, 2013)
- Uttar Pradesh (Uniyal & Hore, 2009)
- West Bengal (Tikader & Patel, 1975; Biswas & Biswas, 1992; Majumder, 2005; Sankaran *et al.*, 2019)

33. *Tropizodium kalami* Prajapati, Murthappa, Sankaran & Sebastian, 2016 *
- Gujarat (Yadav, 2019)
- Karnataka (Prashanthakumara & Venkateshwarlu, 2017)
- Kerala (Prajapati *et al.*, 2016b)

34. *Tropizodium kovvurensis* (Reddy & Patel, 1993) *
syn. *Lutica kovvurensis* Reddy & Patel, 1993
- Andhra Pradesh (Reddy & Patel, 1993; Sankaran *et al.*, 2019)
- Kerala (Sankaran *et al.*, 2019)

35. *Tropizodium poonaensis* (Tikader, 1981) *
syn. *Lutica poonaensis* Tikader, 1981
- Maharashtra (Tikader, 1981a; Sankaran *et al.*, 2019)

36. *Tropizodium viridurbium* Prajapati, Murthappa, Sankaran & Sebastian, 2016 *
- Gujarat (Prajapati *et al.*, 2016b; Yadav, 2019)

37. *Tropizodium* sp.
syn. *Lutica* sp. (all *Lutica* species described in India were transferred to the genus *Tropizodium*)
- Gujarat (Siliwal *et al.*, 2003b)
- Tamil Nadu (Caleb, 2020b)
- Uttar Pradesh (Hore & Uniyal, 2008a, b, c)

38. *Zodarion deccanensis* (Tikader & Malhotra, 1976) *
syn. *Lutica deccanensis* Tikader & Malhotra, 1976
- Maharashtra (Tikader & Malhotra, 1976; Tikader, 1981a; Sankaran *et al.*, 2019)

39. *Zodarion* sp.
- Maharashtra (Lanka *et al.*, 2017)
- Uttarakhand (Uniyal *et al.*, 2011)

Acknowledgments

We thank Dr. Shelley Acharya, Scientist E, Zoological Survey of India, M-Block, Kolkata, India for providing valuable literature.

References

Abhijith, A.P.C. 2019. https://www.mysorenature.org/mysorenature/Spiders-of-Mysore-Area, as on 15/10/2019.

Abhilash, R. & Kumar, A.S. 2018. A survey of spider diversity on the bank of river Pampa at Poovathoor, Pathanamthitta District, Kerala. *Trends in Biosciences*, 11(7): 1025-1028.

Adarsh, C.K. & Nameer, P.O. 2015. Spiders of Kerala Agricultural University Campus, Thrissur, Kerala, India. *Journal of Threatened Taxa*, 7(15): 8288-8295.

Adarsh, C.K. & Nameer, P.O. 2016. A preliminary checklist of spiders (Araneae: Arachnida) in Chinnar Wildlife Sanctuary, Western Ghats, India. *Journal of Threatened Taxa*, 8(4): 8703-8713.

Ahmed, A.F. 2018. A preliminary study on spider diversity in Matia, Goalpara district, Assam, India. *International Journal of Zoology and Applied Biosciences*, 3(4): 369-374.

Almeida-Silva, L.M., Brescovit, A.D. & Dias, S.C. 2009. A new species of *Goeldia* (Araneae: Titanoecidae) with notes on its natural history. *Zoologia*, 26(2): 363-368.

Almeida-Silva, L.M., Griswold, C.E. & Brescovit, A.D. 2010. Revision of the Asian spider genus *Pandava* Lehtinen (Araneae: Titanoecidae): description of five new species and first record of Titanoecidae from Africa. *Zootaxa*, 2630: 30-56.

Asalatha, P.K., Dhali, D.C., Prasadan, P.K. & Sureshan, P.M. 2017. Study on spider fauna (Aranae: Arachnida) of Pookode Lake, Wayanad, Kerala. In. *Mainstreaming Biodiversity for Sustainable Development 2017* (Ed. Cheruvat, D., Nilayangode, P., Oommen, O.V.), Kerala State Biodiversity Board, Thiruvananthapuram, pp. 207-215.

Bastawade, D.B. 2008. Arachnida: Araneae. In: *Fauna of Pin Valley National Park, Conservation Area Series. Zoological Survey of India, Kolkata*, 34: 37-44.

Bhat, P.S., Srikumar, K.K. & Raviprasad, T.N. 2013. Seasonal diversity and status of spiders (Arachnida: Araneae) in cashew ecosystem. *World Applied Sciences Journal,* 22(6): 763-770.

Bhatt, N. 2014. A preliminary systematic study of spiders of major wetlands of Anand-Kheda districts, Gujarat, India. *International Research Journal of Biological Sciences*, 3(7): 71-73.

Bhuvad, N.V., Patil, V.K., Bhave, S.G., Narkhede, S.S., Jalgaonkar, V.N. & Mhaiske, V.M. 2011. Spider diversity attributes in a cultural landscape dominated by field crops and fruit orchards in the Konkan region of Maharashtra. *ENVIS Bulletin: Arthropods and their Conservation in India (Insects & Spiders)*, 14(1): 21-33.

Biswas, B. 1987. Araneae-Spiders (Families: Araneidae, Gnaphosidae and Salticidae). In: *Fauna of Orissa, State Fauna Series* (Eds.), *Zoological Survey of India, Kolkata*, pp. 257-272.

Biswas, B. 1992. Description of a new species of spider (Clubionidae: *Trachelas*) from India. *Records of the Zoological Survey of India,* 91: 53-56.

Biswas, B. & Biswas, K. 1992. Araneae: Spiders. In: *Fauna of West Bengal-3*, *State Fauna Series 3. Zoological Survey of India, Kolkata*, pp. 357-500.

Biswas, B. & Biswas, K. 2006. Araneae: Spiders. In: *Fauna of Arunachal Pradesh, State Fauna Series. Zoological Survey of India, Kolkata*, 13(2): 491-518.

Biswas, B. & Biswas, K. 2007. *Araneae: Spiders.* In: *Fauna of Mizoram, State Fauna Series. Zoological Survey of India, Kolkata*, 14: 455-475.

Biswas, B. & Biswas, K. 2010. Araneae: Spider. Fauna of Uttarakhand-3. In: *State Fauna Series-18* (Ed.), *Zoological Survey of India*, pp. 243-282.

Bodkhe, A.K. & Manthen, S.V. 2014. A new record of the family Phrurolithidae Banks, 1982 (Arachnida: Araneae) from India. *Indian Journal of Arachnology,* 3(2): 82-89.

Bodkhe, A., Uniyal, V., Kamble, S., Manthen, S., Santape, G. & Chikhale, M. 2017. A new species, *Pandava aruni* (Araneae: Titanoecidae) from Lonar Crater Sanctuary, India. *Serket*, 15(3): 119-123.

Bosselaers, J. 2009. Studies in Liocranidae (Araneae): redescriptions and transfers in *Apostenus* Westring and *Brachyanillus* Simon, as well as description of a new genus. *Zootaxa*, 2141: 37-55.

Bradoo, B.L. 1979. *Uloborus ferokus* sp. nov. (Araneae: Uloboridae) a commensal of *Stegodyphus sarasinorum* Karsch. *Bulletin of the British Arachnological Society,* 4: 353-355.

Caleb, J.T.D. 2020a. Spiders (Arachnida: Araneae) from the vicinity of Araabath Lake, Chennai, India. *Journal of Threatened Taxa*, 12(1): 15186-15193.

Caleb, J.T.D. 2020b. Spider (Arachnida: Araneae) fauna of the scrub jungle in the Madras Christian College campus, Chennai, India. *Journal of Threatened Taxa*, 12(7): 15711-15766.

Caleb, J.T.D. & Karthikeyani, R. 2020. JoTT Checklist of the spiders of Tamil Nadu (v1.0), 10 February 2020.

Caleb, J.T.D. & Sankaran, P.M. 2021. Araneae of India, version 2020. https://indianspiders.in. Retrieved on 30 April, 2021.

Caporiacco, L.di 1935. Aracnidi dell'Himalaia e del Karakoram, raccolti dalla Missione italiana al Karakoram 1929-VII). *Memorie della Società Entomologica Italiana, Genova*, 13: 161-263.

Chatterjee, S., Caleb, J.T.D., Tyagi, K., Kundu, S. & Kumar, V. 2018. First report of *Hyptiotes affinis* Bösenberg & Strand, 1906 (Araneae: Uloboridae) from India. *Munis Entomology and Zoology,* 13(1): 211-213.

Chauhan, R., Sihag, V. & Singh, N.P. 2009. Distribution and biocontrol potential of chosen spiders. *Journal of Biopesticides*, 2(2): 151-155.

Chetia, P. & Kalita, D.K. 2012. Diversity and distribution of spiders from Gibbon Wildlife Sanctuary, Assam, India. *Indian Journal of Arachnology*, 1(1): 130-142.

Chetry, A. & Moran, J. 2019. Diversity of Namsai District, Arunachal Pradesh, India. *International Journal of Basic and Applied Research*, 9(7): 343-351.

Choudhury, S.R., Siliwal, M. & Das, S.K. 2019. Spiders of Odisha: a preliminary checklist. *Journal of Threatened Taxa*, 11(9): 14144-14157.

Dankittipakul, P., Jocqué, R. & Singtripop, T. 2012. Systematics and biogeography of the spider genus *Mallinella* Strand, 1906, with descriptions of new species and new genera from Southeast Asia (Araneae, Zodariidae). *Zootaxa*, 3369: 1-327, 3395: 46.

Das, S., Bhattacharjee, R. & Saikia, P.K. 2015. Comprehensive checklist of diurnal spider diversity in Guwahati metropolitan area, Kamrup, Assam. *Tropical Zoology*, 5: 121-131.

De, K., & Palita, S.K. 2018. A checklist of spiders from six sacred groves in Southern Odisha, India. *Serket*, 16(1): 30-40.

Dey, A., Debnath, S., Debbarma, B. & Chaudhuri, P.S. 2013. A preliminary study on spider diversity from a house hold garden artificial mixed plantation in West Tripura, India. *Journal of Research in Biology*, 3: 1009-1017.

Dhali, D.C., Saha, S. & Raychaudhuri, D. 2017. Litter and ground dwelling spiders (Araneae: Arachnida) of reserve forests of Dooars, West Bengal (Monograph). *World Scientific News*, 63: 1-242.

Dondale, C.D. & Redner J.H. 1982. The insects and arachnids of Canada, Part 9. The sac spiders of Canada and Alaska, Araneae: Clubionidae and Anyphaenidae. Research Branch Agriculture Canada Publication, 1724, pp. 1-194.

Ekka, A. & Kujur, R. 2015. Spider diversity of Ram Jharna, Raigarh district, Chhattisgarh, India. *Research Journal of Pharmacy & Technology*, 8(7): 813-819.

Gajbe, P. 2003a. A checklist of spiders (Arachnida: Araneae) of Jabalpur, Madhya Pradesh, India. *Records of Zoological Survey of India, Kolkata*, 101(3-4): 43-47.

Gajbe, P. 2003b. Checklist of spiders (Arachnida: Araneae) of Madhya Pradesh and Chhattisgarh. *Zoo's Print Journal*, 18(10): 1223-1226.

Gajbe, P.U. 2004. Spiders of Jabalpur, Madhya Pradesh (Arachnida: Araneae). *Records of the Zoological Survey of India, Occasional Paper,* 227: 1-154.

Gajbe, U.A. 1992. Description of the male of *Uloborus danolius* Tikader (Araneae: Uloboridae). *Records of the Zoological Survey of India,* 91: 235-237.

Gajbe, U.A. 2004. Studies on some spiders of the families Oecobiidae, Eresidae, Hersiliidae, Urocteidae and Uloboridae (Araneae: Arachnida) from Madhya Pradesh, India. *Records of the Zoological Survey of India*, 103(1-2): 131-142.

Gajbe, U.A. 2007. Araneae: Arachnida. State Fauna Series. In: *Fauna of Madhya Pradesh (including Chhattisgarh)*, Zoological Survey of India, Kolkata, 15(1): 419-540.

Gajbe, U.A. & Sharma, H.S. 1994. On some spiders (Araneae: Arachnida) from Bastar district (Madhya Pradesh) India. *Records of the Zoological Survey of India,* 94(2-4): 233-245.

Ghosh, N., Biswas, R. & Mitra, A. 2018. Species diversity, abundance and habitat association of spiders with relation to their guild composition in different habitats of North Bengal Wild Animals Park (Bengal Safari). *International Journal of Life Sciences*, 6(4): 911-918.

Gravely, F.H. 1921. The spiders and scorpions of Barkuda Island. *Records of the Indian Museum, Calcutta*, 22: 399-421.

Griswold, C.E., Ramirez, M.J., Coddington, J.A. & Platnick, N.I. 2005. Atlas of phylogenetic data for entelegyne spiders (Araneae: Araneomorphae: Entelegynae) with comments on their phylogeny. In: *Proceedings of the California Academy of Sciences,* 1-324.

Gupta, N. & Siliwal, M. 2012. A checklist of spiders (Arachnida: Araneae) of Wildlife Institute of India campus, Dehradun, Uttarakhand, India. *Indian Journal of Arachnology*, 1(2): 73-91.

Hingston, R.W.G. 1927. Protective devices in spiders' snares, with a description of seven new species of orb-weaving spiders. *Proceedings of the Zoological Society of London,* 1927: 259-293.

Hore, U. & Uniyal, V.P. 2008a. Effect of prescribed fire on spider assemblage in Terai grasslands, India. *Turkish Journal of Arachnology*, 1(1): 15-36.

Hore, U. & Uniyal, V.P. 2008b. Diversity and composition of spider assemblages in five vegetation types of the Terai Conservation Area, India. *The Journal of Arachnology*, 36(2): 251-258.

Hore, U. & Uniyal, V.P. 2008c. Use of spiders (Araneae) as indicator for monitoring of habitat conditions in Tarai Conservation Area, India. *Indian Forester*, 134: 1371-1380.

Hu, J.L. & Li, A.H. 1987. The spiders collected from the fields and the forests of Xizang Autonomous Region, China. Agricultural Insects, Spiders, Plant Diseases and Weeds of Xizang, 1: 315-392.

Jocqué, R. 1991. A generic revision of the spider family Zodariidae (Araneae). *Bulletin of the American Museum of Natural History*, 201: 1-160.

Jose, A.C., Sudhin, P.P., Prasad, P.M. & Sreejith, K.A. 2018. Spider diversity in Kavvayi river basin, Kerala, Southern India. *Current World Environment*, 13(1): 100-112.

Joseph, M.M., Paul, J., Sankaran, P.M. & Sebastian, P.A. 2017. Preliminary results on the spider fauna (Arachnida: Araneae) of the high altitude shola ecosystem in the Western Ghats. *Proceedings of the National Conference on Ecology Sustainable Development and Wildlife Conservation*, pp. 41-49.

Kapoor, V. 2008. Effects of rainforest fragmentation and shade-coffee plantations on spider communities in the Western Ghats, India. *Journal of Insect Conservation,* 12: 53-68.

Karthikeyani, R. 2013. Biodiversity of spiders (Araneae) in Kumbakarai Falls, Periyakulam Taluk, Theni District, Tamil Nadu, South India. Ph.D. thesis, Madurai Kamaraj University, Madurai, 288 pp.

Karthikeyani, R., Caleb, J.T.D., Gajbe, U.A. & Muthuchelian, K. 2017. Checklist of spiders (Arachnida: Araneae) of the State of Tamil Nadu, India. *Munis Entomology & Zoology*, 12(1): 180-193.

Kaur, M., Das, S.K., Anoop, K.R. & Siliwal, M. 2014. Preliminary checklist of spiders of Keoladeo National Park, Bharatpur, Rajasthan with first record of *Ptocasius strupifer* Simon, 1901 (Araneae: Salticidae) from India. *Munis Entomology and Zoology*, 9(1): 501-509.

Keswani, S. 2014. Diversity, population and microhabitat used by spiders in citrus agroecosystem. *Indian Journal of Arachnology*, 3(2): 90-101.

Keswani S. & Vankhede G. 2014. Diversity, population and habitat used by spiders in bananaagro-ecosystem. *Indian Journal of Arachnology*, 3(1): 12-27.

Keswani, S., Hadole, P. & Rajoria, A. 2012. Checklist of spiders (Arachnida: Araneae) from India. *Indian Journal of Arachnology*, 1(1): 1-129.

Kokilamani A.L., Lokeshkumar, P., Rakesh, B.O., Sahana, R. & Geetha, H.C. 2019. A preliminary study on diversity of spiders from Tumkur University Campus, Tumakuru, India. *International Journal of Advanced Scientific Research and Management*, 4(2): 84-87.

Kujur, R. & Ekka, A. 2016. Exploring the spider fauna of Gomarda Wildlife Sanctuary, Chhattisgarh, India. *International Research Journal of Biological Sciences*, 5(6): 31-36.

Kumar, A., Kanaujia, A., Kumar, A., Kumar, V. & Mishra, H. 2017. Diversity of spiders in Kukrail Reserve Forest, Lucknow, Uttar Pradesh, India. *Journal of Environmental Science and Technology*, 4(5): 101-104.

Kumari, V., Saini, K.C. & Singh, N.P. 2017. Diversity and distribution of spider fauna in arid and semi-arid region of Rajasthan. *Journal of Biopesticides*, 10(1): 17-24.

Lanka, L.P., Kamble, S.S. & Bodkhe, A.K. 2017. An Addition to spider fauna from the vicinity of Radhanagari Wildlife Sanctuary of Kolhapur district. *International Journal of Scientific Engineering and Research*, 5(7): 280-283.

Lawania, K.K. & Mathur, P. 2014a. Baseline studies on the spider fauna (Araneae) of Braj region (Braj-Bhoomi), India. *International Journal of Basic and Applies Biology*, 2(1): 137-141.

Lawania, K.K. & Mathur, P. 2014b. Diversity and distribution of spider fauna in and around the Taj Mahal and Taj Protected Forest, Agra (U.P.), India. *International Journal of Basic and Applied Biology*, 2(2): 111-114.

Lawania, K.K. & Mathur, P. 2014c. On the diversity of spiders in and around Sur-Sarovar Bird Sanctuary, Agra (U.P.), India. *International Journal of Basic and Applied Biology*, 2(3): 189-194.

Lawania, K.K. & Mathur, P. 2014d. Diversity and distribution of spiders in and around Vrindavan, Mathura, (UP), India. *International Journal of Basic and Applied Biology*, 2(2): 115-119.

Lawania, K.K. & Mathur, P. 2017a. Biodiversity and habit preference of spider fauna in eastern region of Rajasthan and its catchment area. *International Journal of Scienticifc Development and research*, 2(6): 475-484.

Lawania, K.K. & Mathur, P. 2017b. Seasonal abundance and population indices of spider fauna in summer seasons of the years 2013 to 2016 from different habitats of eastern region of Rajasthan, India. *International Journal for Research Trends and Innovation*, 2(2): 420-427.

Lawania, K.K. & Trigunayat, M.M. 2015. A comparative study of the spider (Araneae) fauna in Keoladeo National Park (KNP), Nahargarh Wildlife Sanctuary (NWS) and Sur-sarovar Bird Sanctuary (SBS), India. *International Journal on Agricultural Sciences*, 6(1): 141-146.

Leardi in Airaghi, Z. 1901a. Aracnidi d'Almora. *Atti della Societa Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano,* 40: 85-94.

Leardi in Airaghi, Z. 1901b. Aracnidi di Mahé e Kandy. *Atti della Societa Italiana di Scienze Naturali e del Museo Civico di Storia Naturale di Milano,* 40: 345-373.

Lehtinen, P.T. 1967. Classification of the cribellate spiders and some allied families, with notes on the evolution of the suborder Araneomorpha. *Annales Zoologici Fennici*, 4: 199-468.

Logunov, D.V. 2018. Three new spider species of the genus *Miagrammopes* O. Pickard-Cambridge, 1870 (Aranei, Uloboridae) from Southeast Asia. *Euroasian Entomological Journal*, 17(4): 280-289.

Maheshwari, N.R., Marathe, J.M., Patil, S.R. & Chopda, M.Z. 2019. First description of the male of *Uloborus jabalpurensis* Bhandari & Gajbe, 2001 (Araneae: Uloboridae). *Serket,* 17(1): 27-31.

Majumder, S.C. 2004. Taxonomic studies of some spiders from mangrove and semi-mangrove areas of Sundarban. *Memoirs of the Zoological Survey of India*, 20(2): 1-42.

Majumder, S.C. 2005. Studies on some spiders from eastern coastal region of India. *Memoirs of the Zoological Survey of India*, 20(3): 1-57.

Majumder, S.C. 2007. *Pictorial handbook on spiders of Sunderbans, West Bengal*. Zoological Survey of India, 138 pp.

Majumder, S.C. & Talukdar, S. 2013. Studies on Taxonomy and diversity of spiders from Darjeeling Hills with special reference to family Clubioneidae in light of conservation. *Records of the Zoological Survey of India, Kolkata, Occasional Paper No. 340*, 96 pp.

Majumder, S.C. & Tikader, B.K. 1991. Studies on some spiders of the family Clubionidae from India. *Records of the Zoological Survey of India, Occasional Paper*, 102: 1-175.

Malamel, J.J. & Samson, P.D. 2014. A pioneering study on the spider (Arachnida: Araneae) fauna of Kumarakom Bird Sanctuary. *International Journal of Science, Environment and Technology*, 3(3): 872-880.

Malhotra, G.S., Neera, K. & Saxena, M.M. 2019. Spider diversity and abundance in different habitats of Upper-Northern Rajasthan. *ESSENCE International Journal for Environmental Rehabilitation and Conservation*, 10(1): 1-14.

Malik, V. & Goyal, V. 2017. Biodiversity of spiders in different habitats of Western Haryana, India. *Journal of Entomology and Zoology Studies*, 5(4): 822-825.

Marusik, Y.M., Omelko, M.M. & Koponen, S. 2018. Redescription of the Himalayan *Trachelas costatus* (Araneae: Trachelidae). *Zootaxa*, 4433(2): 390-392.

Mathew, E.V., Sudhikumar, A. & Sebastian, P.A. 2014. Vertical stratification of spiders in Kuttanad rice agroecosystem, Kerala. *Journal of Biological Control*, 28(2): 62-67.

Meshram, A. 2011. Spiders (Arachnida: Araneae) from Toranmal Sanctuary, Maharashtra, India. *E-International Scientific Research Journal*, (4): 326-334.

Mohapatra, A.K., Biswas, T. & Parida, S.P. 2014. Spider diversity in RIE campus. RIE, Bhubaneswar, 76 pp.

Molur, S., Siliwal, M. & Daniel, B.A. 2008. At last! Indian tarantulas on IUCN Red List. Zoos' Print, 23(12): 1-3.

More, S.B. 2015. Spider diversity from Vakoba, Devrai region of Radhanagari Wildlife Sanctuary. *International Journal of Science and Research,* 4(6): 179-181.

More, S. & Sawant, V. 2013. Spider Fauna of Radhanagari Wildlife Sanctuary, Chandoli National Park and Koyna Wildlife Sanctuary. *Indian Journal of Arachnology*, 2(1): 81-92.

Mubeen, M. & Basavarajappa, S. 2018. Density, abundance and per cent occurrence of spider species (Arachnida: Araneae) in and around Mysore city, Karnataka, India – a case study. *IOSR Journal of Pharmacy and Biological Sciences*, 13(3): 31-40.

Nalini Bai, G. & Ravindranatha, B.P. 2012. Spider diversity in IISC, Bangalore, India. *Indian Journal of Arachnology*, 1(2): 50-58.

Nautiyal, S., Khan, Y.D.I., Kaechele, H. & Bhaskar, K. 2017. Diversity and distribution of spiders in Gogi, Yadgir District: a semi-arid landscape in southern India. *International Journal of Ecology and Environmental Sciences*, 43(3): 195-204.

Nerlekar, A.N., Warudkar, A.M., Gowande, G.G., Salve, S.S., Raut, A., Patankar, S.R. & Nalavade, S.B. 2016. A review of the faunal diversity of the Fergusson College campus, Pune, India. *Zoo's Print*, 31(10): 4-25.

Nijagal B.S., Padma, S., Michael, A. & D'souza, L. 2020. Species composition, density, abundance and percent occurrence of spiders at three different sites of Mysore city, Karnataka. *IOSR Journal of Pharmacy and Biological Sciences*, 15(3): 23-29.

Opell, B.D. 1988. Ocular changes accompanying eye loss in the spider family Uloboridae. Journal of Morphology, 196(2):119-126.

Palem, H., Kanike, S. & Purushottam, V.R.S. 2016. Diversity of spider fauna (Arachnida: Araneae) in different ecosystems, Eastern Ghats, Southern Andhra Pradesh, India. *South Asian Journal of Life Sciences*, 4(2): 51-60.

Panda, S., Mishra, S., Priyadarshini, D. & Parida, P. 2011. *Spiders of Nandankanan*. Forest Department, Government of Odisha, 64 pp.

Pandit, R. & Dharwadkar, M. 2020. Preliminary checklist of spider fauna (Araneae: Arachnida) of Chandranath Hill, Goa, India. *Journal of Threatened Taxa*, 12(11): 16597-16606.

Pandit, R. & Pai, I. 2017. Spiders of Taleigao Plateau, Goa, India. *Journal of Environmental Science and Public Health*, 1(4): 240-252.

Parasharya, B.M. & Pathan, V.A. 2013. Diversity of spider fauna in Lucerne (*Medicago sativa* L.). *Journal of Biological Control*, 27(4): 253-259.

Parmar, B.M. 2013. The spider diversity from different habitats around Biosciences, Vallabh Vidyanagar. *International Journal of Science and Research*, 4(10): 1985-1988.

Parmar, B.M. 2020. The diversity of spiders from the vicinity of Dharoi Reservoir, North Gujarat, India. *Serket*, 17(3): 194-200.

Parmar, B.M. & Patel, K.B. 2015. Preliminary Study of Spiders (Order: Araneae) from Taranga Hills. *International Journal of Science and Research*, 6(11): 23-25.

Parmar, B.M., Patel, K.B., Joshi, J.D. & Chaudhari, N.R. 2015. Faunastic study of spiders diversity from islands and coastal areas of Gulf of Kutch, India. *Life Sciences Leaflets*, 67: 12-23.

Patel, B.H. 2003a. Fauna of Protected Areas - A Preliminary list of Spiders with the descriptions of three new species from Parambikulum Wildlife sanctuary, Kerala. *Zoos' Print Journal*, 18(10): 1207-1212.

Patel, B.H. 2003b. Spiders of Vansada National Park, Gujarat. *Zoos' Print Journal*, 18(4):1079-1083.

Patel, B.H. & Patel, H.K. 1975. A new record of the family Amaurobiidae (Arachnida: Araneae) from India. *Journal of the Bombay Natural History Society,* 72: 800-803.

Patel, B.H. & Pillai, G.K. 1988. Studies on the spider fauna of groundnut fields in Gujarat, India. *Journal of Biological Control*, 2(2): 83-88.

Patel, B.H. & Reddy, T.S. 1989. On some rare spiders of the family Zodariidae (Araneae: Arachnida) from coastal Andhra Pradesh, India.*Journal of the Bombay Natural History Society* 86: 221-225.

Patel, B.H. & Reddy, T.S. 1990. A new species of *Amaurobius* Koch (Araneae: Amaurobiidae) from coastal Andhra Pradesh, India. *Entomon* 15: 41-43.

Patel, B.H. & Vyas, R. 2001. Spider of Hingolgadh Nature Education Sanctuary, Gujarat, India. *Zoos' Print Journal,* 16(9): 589-590.

Patil, S.R. 2012. Spiders of Jabalpur district (Arachnida: Araneae): updated checklist 2011. *Indian Journal of Arachnology*, 1(1): 143-149.

Patil, S.R., Roy, S. & Bano, R. 2016. A note on soil spiders (Arachnida: Araneae) from Jaisalmer district, Rajasthan. *International Journal of Fauna and Biological Studies*, 3(2): 22-23.

Pickard-Cambridge, O. 1870. Descriptions and sketches of two new species of Araneida, with characters of a new genus. *Journal of the Linnean Society of London, Zoology*, 10(47): 398-405.

Picard-Cambridge, O. 1885. Araneidea. In: Scientific results of the second Yarkand mission; based upon the collections and notes of the late Ferdinand Stoliczka, Ph. D. Government of India, Calcutta, 115 pp.

Platnick, N.I. 2002. A revision of the Australasian ground spiders of the families Ammoxenidae, Cithaeronidae, Gallieniellidae, and Trochanteriidae (Araneae: Gnaphosoidea). *Bulletin of the American Museum of Natural History*, 271: 1-243.

Platnick, N.I. & Shadab, M.U. 1974. A revision of the spider family Stenochilidae (Arachnida, Araneae). *American Museum Novitates*, 2556: 1-14.

Pocock, R.I. 1899. Diagnoses of some new Indian Arachnida. *Journal of the Bombay Natural History Society*, 12: 744-753.

Pocock, R.I. 1900. *The Fauna of British India including Ceylon and Burma Arachnida*. Taylor and Francis London, London, 279 pp.

Pocock, R.I. 1901. Descriptions of some new species of spiders from British India.*Journal of the Bombay Natural History Society*, 13: 478-498.

Pocock, R.I. 1904. Arachnida. In: *Fauna and Geography of the Maldive and Laccadive Archipelagoes*. London, 2: 797-805.

Pooja, A., Anilkumar, Quasin, S., Lekshmi, S. & Uniyal, V.P. 2019. Spider Fauna of Navdanya Biodiversity Farm, Uttarakhand. *India.Indian Forester*, 145(4): 392-397.

Prajapati, D.A., Patel, K.R., Munjpara, S.B., Chettiar, S.S. & Jhala, D.D. 2016a. Spiders (Arachnida: Araneae) of Gujarat University Campus, Ahmedabad, India with additional description of *Eilica tikaderi* (Platnick, 1976). *Journal of Threatened Taxa*, 8(11): 9327-9333.

Prajapati, D.A., Murthappa, P.S., Sankaran, P.M. & Sebastian, P.A. 2016b. Two new species of the ant-eating spider genus *Tropizodium* Jocqué & Churchill, 2005 (Araneae, Zodariidae, Zodariinae) from India. *Zootaxa*, 4061(5): 575-584.

Prajapati, J.N., Patel, S.R. & Surani P.M. 2018. Pictorial checklist of agrobiont spiders of Navsari Agricultural University, Navsari, Gujarat, India.International *Journal of Current Microbiology and Applied Sciences*, 7(7): 409-420.

Prashanthakumara, S.M. & Venkateshwarlu, M. 2017. Preliminary study of spiders (Araneae: Arachnida) in Gudavi Bird Sanctuary, Shivamogga, Karnataka. *International Journal of Recent Scientific Research*, 8(8): 19277-19281.

Quasin, S. & Uniyal, V.P. 2010. Preliminary Investigation of spider diversity in Kedarnath Wildlife sanctuary, Uttarakhand, India. *Indian Forester*, 136(10): 1340-1345.

Quasin, S., Siliwal, M. & Uniyal, V.P. 2018. New species of *Trachelas* (Araneae: Trachelidae) from Nanda Devi Biosphere Reserve-Western Himalaya, India. *Journal of Asia-Pacific Biodiversity*, 11(1): 158-160.

Rajeevan, S., Kunnath, S.M., Varghese, T. & Kandambeth, P.P. 2019. Spider diversity (Arachnida: Araneae) in different ecosystems of the Western Ghats, Wayanad Region, India. *South Asian Journal of Life Science*, 7(2): 29-39.

Rajoria, A. 2015. A new species of the genus *Migrammopes* (Arachnida: Araneae: Uloboridae) from India. *Indian Journal of Arachnology* 4(2): 48-51.

Ramirez, M.J. 1995. A phylogenetic analysis of the subfamilies of Anyphaenidae (Arachnida: Araneae). *Scandinavian Entomology*, 26: 361-384.

Ramírez, M.J. 2014. The morphology and phylogeny of dionychan spiders (Araneae, Araneomorphae). *Bulletin of the American Museum of Natural History*, 390: 1-374.

Ramírez, M.J., Grismado, C.J., Labarque, F.M., Izquierdo, M.A., Ledford, J.M., Miller, J.A., Haddad, C.R. & Griswold, C.E. 2014. The morphology and relationships of the walking mud spiders of the genus *Cryptothele* (Araneae: Zodariidae). *Zoologischer Anzeiger - A Journal of Comparative Zoology*, 253(5): 382-393.

Raychaudhuri, D., Saha, S. & Roy, T.K. 2016. Spiders: a proficient candidate in practising IPM for Darjeeling tea. *World Scientific News*, 38: 1-62.

Reddy, T.S. & Patel, B.H. 1993. A rare new spider *Lutica* Marx (Araneae: Zodariidae) from India. *Records of the Zoological Survey of India*, 92: 173-175.

Reimoser, E. 1934. Araneae aus Süd-Indien. *Revue Suisse de Zoologie*, 41: 465-511.

Rithe, K. 2012. Spider diversity from relocated area of Melghat Tiger Reserve. *Indian Journal of Arachnology*, 1(2): 92-105.

Roy, T.K., Saha, S. & Raychaudhuri, D. 2017. Spider Fauna of Meghalaya, India. in: *Biodiversity : Exploration, Exploitation, Conservation and Management - Vision and Mission*. Proceedings of the UGC Sponsored National Seminar, Kolkata, India, 19-20th November, 2016 (Eds. Saha, S., Manna, M., Ghosh, J., Podder, S., Haque, E., Guria, S. and Dey S.). *World Scientific News*, 71: 104-127.

Saha, S., Roy, T.K. & Raychaudhuri, D. 2016. Survey on spider faunal diversity of darjeeling tea plantations. *Munis Entomology and Zoology*, 11(2): 622-635.

Sankaran, P.M., Caleb, J.T.D. & Sebastian, P.A. 2019. Transfer of the Indian species formerly included in the genus *Lutica* Marx, 1891 to *Tropizodium* Jocqué & Churchill, 2005 and *Zodarion* Walckenaer, 1826 (Araneae, Zodariidae). *Zootaxa,* 4658(1): 168-174.

Sankaran, P.M., Caleb, J.T.D., Joseph, M.M. & Sebastian, P.A. 2020a. The species of the genus *Plator* Simon, 1880 in India (Araneae: Trochanteriidae). *Zootaxa*, 4852 (1): 133-141.

Sankaran, P.M., Caleb, J.T.D. & Sebastian, P.A. 2020b. A review of the Indian species formerly assigned to the genus *Storena* Walckenaer, 1805 (Araneae: Zodariidae) with the description of a new genus. *European Journal of Taxonomy*, 707: 1-23.

Sankaran, P.M., Jobi, M.J., Joseph, M.M. & Sebastian, P.A. 2014. On the genus *Hermippus* Simon, 1893 (Araneae: Zodariidae, Zodariinae) in India with the description of three new species from the Western Ghats and proposing a new biogeographical hypothesis for the distribution of the genus. *Zootaxa*, 3893(1): 114-126.

Sawane, A.P. 2016. Diversity and distribution of spiders (Arachnids: Aranae) from Chandrapur District, Maharashtra, India. *International Interdisciplinary Research Journal*, 6(1): 70-72.

Sebastian, P.A., Murugesan, S., Mathew, M.J., Sudhikumar, A.V. & Sunish, E. 2005a. Spiders in Mangalavanam, an ecosensitive mangrove forest in Cochin, Kerala, India (Araneae). *European Arachnology-Acta Zoologica Bulgarica*, Suppl. No.1: 315-318.

Sebastian, P.A., Mathew, M.J., Beevi, S.P., Joseph, J. & Biju, C.R. 2005b. The spider fauna of the irrigated rice ecosystem in central Kerala, India across different elevational ranges. *The Journal of Arachnology,* 33(2): 247-255.

Sen, S., Saha, S. & Raychaudhuri, D. 2013. A new species of the genus *Miagrammopes* O.P. Cambridge, 1870 (Araneae: Uloboridae) from India. *Munis Entomology and Zoology*, 8(1): 42-45.

Sen, S., Dhali, D.C., Saha, S. & Raychaudhuri, D. 2015. Spiders (Araneae: Arachnida) of Reserve Forests of Dooars: Gorumara National Park, Chapramari Wildlife Sanctuary and Mahananda Wildlife Sanctuary. *World Scientific News*, 20: 1-339.

Sharma, P. & Sharma, V.K. 2015. Diversity of spiders around Sirpur Lake, Indore (M.P.), India. *International Journal of Zoology and Research*, 5(2): 1-8.

Sharma, A., Singh, R. & Singh, G. 2020a. Faunal diversity of Liocranidae, Mimetidae, Miturgidae, Nesticidae and Oecobiidae (Arachnida: Araneae) of India. *Serket,* 17(3): 270-283.

Sharma, A., Singh, G. & Singh, R. 2020b. Faunal diversity of Linyphiidae (Araneomorphae: Araneae: Arachnida) in India. *Asian Journal of Conservation Biology,* 9(2): 304-314.

Sharma, A., Singh, G. & Singh, R. 2021. Faunal diversity of spider families Dictynidae, Dysderidae, Eresidae and Filistatidae (Araneomorphae: Araneae: Arachnida) in India. *International Journal of Zoology and Applied Biosciences*, 6(1): 1-9.

Sherriffs, W.R. 1919. A contribution to the study of south Indian arachnology. *Annals and Magazine of Natural History,* (9)4: 220-253.

Sherriffs, W.R. 1927. South Indian arachnology. Part II. *Annals and Magazine of Natural* History, 9-19(13): 533-542.

Sherriffs, W.R. 1928. South Indian Arachnology. Part III. *Annals and Magazine of Natural History*, (10) 2: 177-192.

Siddhu, J., Lohani, H.P., Pathak, G. & Kaushal, B.R. 2020. Spider diversity in rice and mix vegetable agro bhabar region of Nainital district, Uttarakhand. *Bulletin of Environment, Pharmacology and Life Sciences,* 9(2): 101-105.

Siliwal, M., Molur, S. & Biswas, B.K. 2005. Indian spiders (Arachnida, Araneae): updated checklist 2005. *Zoo's Print Journal,* 20(10): 1999-2049.

Siliwal, M., Molur, S. & Daniel, B.A. 2008. Status and conservation of tarantulas in selected hot specks of southern India. Report submitted to Fauna and Flora International, UK, 57 pp.

Siliwal, M., Suresh, B., Dhuru, S. & Pilo, B. 2003a. Spider diversity of riparian zone of river Vishwamitri, Gujarat. *Journal of Current Science* 3(2): 429-434.

Siliwal, M., Suresh, B. & Pilo, B. 2003b. Fauna of protected areas-3. Spiders of Purna Wildlife Sanctuary, Dangs, Gujarat. *Zoos' Print Journal*, 18(11): 1259-1263.

Simon, E. 1889. Arachnides de l'Himalaya, recueillis par M.M. Oldham et Wood-Mason, et faisant partie des collections de l'Indian Museum. Première partie. *Journal of the Asiatic Society of Bengal*, 58: 334-344.

Simon, E. 1897. Matériaux pour servir à la faune arachnologique de l'Asie méridionale. V. Arachnides recueillis à Dehra-Dun (N.W. Prov.) et dans le Dekkan par M.A. Smythies. *Mémoires de la Société Zoologique de France*, 10: 252-262.

Simon, E. 1905. Arachnides (1re partie). In: Voyage de M. Maurice Maindron dans l'Inde méridionale. 7e Mémoire. *Annales de la Société Entomologique de France*, 74: 160-180.

Simon, E. 1906a. Arachnides (2e partie). In: Voyage de M. Maurice Maindron dans l'Inde méridionale. 8e Mémoire. *Annales de la Société Entomologique de France*, 75: 279-314.

Simon, E. 1906b. Etude sur les araignées de la section des cribellates. *Annales de la Société Entomologique de Belgique*, 50: 284-308.

Singh, R. 2021a. Distribution of Sparassidae (Araneomorphae: Araneae: Arachnida) in India. World *Journal of Pharmaceutical & Life Sciences*, 7(3): 82-89.

Singh, R. 2021b. Faunal biodiversity of Tetragnathidae (Araneomorphae: Araneae: Arachnida) in India. *International Journal of Biological Innovations*, 3(1): 92-119.

Singh, R. 2021c. Faunal biodiversity of Lycosidae (Araneomorphae: Araneae: Arachnida) in India: an updated checklist. *International Journal of Zoological Investigations*, 7(1): 110-158.

Singh, R. & Singh, G. 2020. Diversity of mygalomorph spiders (Aranae: Opisthothelae) in India. *International Journal of Biological Innovations*, 2(2): 178-201.

Singh, S., Borkotoki, A. & Sarmah, C.K. 2012. Species distribution of spiders in barpeta district of Assam: a diversity measure. *International Scientific Research Journal*, 4(1): 47-57.

Singh, S., Sarmah, C.K. & Borkotoki, A. 2013. Non-parametric estimate of spider species richness in Barpeta district, Assam, India. *Indian Journal of Arachnology*, 2(2): 22-33.

Singh, R., Singh, G. & Sharma, A. 2020a. Diversity of yellow sac spiders (Cheiracanthiidae: Araneae: Arachnida) in India. *Journal of Entomology and Zoology Studies*, 8(6): 118-126.

Singh, R., Singh, G. & Sharma, A. 2020b. Faunal diversity of Hahniidae, Hersiliidae and Homalonychidae (Arachnida: Araneae: Araneomorphae) in India. *Serket*, 17(3): 240-251.

Singh, R., Singh, G. & Singh, B.B. 2020c. Diversity of Asemoneinae, Eupoinae, Hisponinae, Lyssomaninae, Onomastinae and Spartaeinae (Arachnida: Araneae: Salticidae) in India: a checklist and bibliography. *Research Journal of Life Sciences, Bioinformatics, Pharmaceuticals & Chemical Science*, 6(5): 29-46.

Singh, R., Singh, G. & Singh, B.B. 2020d. Diversity of Amycoida and Astioida (Arachnida: Araneae: Salticidae: Salticinae) in India. *Journal of Entomology and Zoology Studies*, 8(5): 1478-1488.

Singh, R., Singh, G. & Singh, B.B. 2020e. Diversity of Marpissoida, Chrysillini and Hasariini (Arachnida: Araneae: Salticidae: Salticinae) in India. *Research Journal of Life Sciences, Bioinformatics, Pharmaceuticals & Chemical Science*, 6(6): 15-42.

Singh, R., Singh, G. & Singh, B.B. 2020f. Diversity of simonid spiders (Araneae: Salticidae: Salticinae) in India. *International Journal of Biological Innovations*, 2(2): 247-276.

Singh, B.B., Singh, R. & Singh, G. 2020g. Faunal diversity of Clubionidae, Ctenidae, Cybaeidae, Deinopidae and Desidae (Araneomorphae: Araneae: Arachnida) in India. *Journal of Applied Bioscience,* 46(1, 2): 1-12.

Singh, B.B., Singh, R. & Singh, G. 2021a. Faunal diversity of spitting spiders (Scytodidae: Araneomorphae: Araneae: Arachnida) in India. *World Journal of Pharmaceutical & Life Sciences*, 7(3): 82-89.

Singh, R., Singh, G. & Singh, B.B. 2021b. Faunal diversity of jumping spiders (Salticidae: Araneae: Arachnida) in India. *International Journal of Biological Innovations*, 3(1): 1-37.

Solanki, R. 2016. Ecology and diversity of spider fauna in southern tropical dry deciduous forests of Gujarat. Ph.D. Thesis, The M.S.University of Baroda, Vadodara Gujarat, India, 305 pp.

Solanki, R. & Kumar, D. 2015. Spiders (Araneae) from five major agroecosystems of Jambughoda village, Panchmahal district, Gujarat, India. *International Journal of Science and Research*, 4(9): 958-961.

Solanki, R., Siliwal, M. & Kumar, D. 2017. First record of *Pandava laminata* (Thorell, 1878) (Araneae: Titanoecidae) from India. *European Journal of Zoological Research*, 5(1): 23-27.

Solanki, R., Siliwal, M. & Kumar, D. 2018. Transfer of *Storena gujaratensis* Tikader & Patel, 1975 to the genus *Suffasia* Jocqué, 1991 (Araneae: Zodariidae). *Journal of Threatened Taxa*, 10(8): 12130-12132.

Solanki, R., Siliwal, M. & Kumar, D. 2020. A preliminary checklist of spiders (Araneae: Arachnida) in Jambughoda Wildlife Sanctuary, Panchmahal District, Gujarat, India. *Journal of Threatened Taxa*, 12(11): 16576-16596.

Sudhikumar, A.V., Mathew, M.J., Sunish, E., Murugesan, S. & Sebastian, P.A. 2005. Preliminary studies on the spider fauna in Mannavan shola forest, Kerala, India (Araneae). *European Arachnol.- Acta Zoologica Bulgarica*, Suppl. No.1: 319-327.

Sudhikumar, A.V., Maelfait, J.P., Lens, L., Hendrickx, F. & Sebastian, P.A. 2008. African and Southeast Asian elements in the spider fauna of Western Ghats of India. *Proceedings of the 24th European Congress of Arachnology, Bern, 25-29 August, 2008, European Arachnology*, pp. 165-175.

Sudhikumar, A.V., Jocqué, R. & Sebastian, P.A. 2009. A new species of the ant spider genus *Suffasia* (Araneae: Zodariidae) from the Western Ghats, India with a key to the species of the genus. *Zootaxa*, 2203: 59-64.

Sugumaran, M.P., Soundararajan, R.P. & Lakshamanan, V. 2007. Spider fauna in the horticultural crops of Yercaud hills. *Zoos' Print Journal*, 22(6): 2721-2722.

Sunil Jose, K., Sudhikumar, A.V., Davis, S. & Sebastian, P.A. 2008. Preliminary studies on the spider fauna (Arachnida: Araneae) in Parambikulam Wildlife Sanctuary in Western Ghats, Kerala, India. *Journal of the Bombay Natural History Society*, 105(3): 264-273.

Suthar, A.R., Rathod, J.Y. & Gavali, D.J. 2017. Rapid survey of spider diversity at Piplaidevi forest range, Dangs, Gujarat. *International Journal of Entomology Research*, 2(4): 12-15.

Tabasum N.R., Nagaraj B, Shantakumari, S., Sreenivasa, V. & Sai Sandeep, Y. 2018. Assessment of spider diversity and composition along the Tungabhadra Irrigation Channel at Ballari, Karnataka. *International Journal on Biological Sciences*, 9(1): 36-44.

Talukdar, S. 2015. Taxonomy and zoo-geography of a trochanteried crabspider *Plator indicus* Simon, 1880 from Darjeeling hills, a new distribution of spider from West Bengal. *Records of Zoological Survey of India, Kolkata,* 115(2): 167-170.

Talukdar, S. & Majumder, S.C. 2008. Diversity of spider fauna of Bortibeel North 24 Parganas, West Bengal, their possible utilities as significant biological pestcontrol in the paddy field-ecosystem. *Records of the Zoological Survey of India*, 108(2): 39-45.

Talwar, S., Majagi, S., Bodkhe, A. & Kamble, S. 2018. New report of genus *Euryeidon* Dankittipakul & Jocque, 2004 from India (Araneae: Zodariidae) with description of two new species. In: *Biodiversity and bioprospects: Indian scenario and perspectives* (eds. Rao, P.N., Saxena, A., Pandey, B.N. & Kulkarni, G.K.) .Today & Tomorrow's Printers and Publishers, New Delhi, pp. 67-79.

Tandon, P.L. & Lal, B. 1983. Predatory spiders associated with insect pests of mango in India. *Bulletin of Entomology*, 24: 144-147.

Thorell, T. 1891. Spindlar från Nikobarerna och andra delar af södra Asien. *Kongliga Svenska Vetenskaps-Akademiens Handlinga*r, 24(2): 1-149.

Thumar R.H. 2019. *Biodiversity and taxonomic study of predacious spiders of some orchard plants in and around Navsari district*. Gujarat. Ph.D. thesis, Veer Narmad South Gujarat University, Surat, Gujarat, 261 pp.

Tikader, B.K. 1961. Protectivc devices of somc orbweaving spiders from India. *The Journal of the Bombay Natural History Society*, 58(3): 826-829.

Tikader, B.K. 1969a. Studies of some rare spiders of the families Selenopidae and Platoridae from India. *Proceedings of the Indian Academy of Science*, 69(B): 252-255.

Tikader, B.K. 1969b. Two new spiders of the genus *Uloborus* of the family Uloboridae from India. *Proceedings of the Indian Academy of Science*, 70(B): 127-130.

Tikader, B.K. 1970. Spider fauna of Sikkim. *Records of the Zoological Survey of India*, 64: 1-83.

Tikader, B.K. 1971. Descriptions of some little known spiders from India of the genus *Miagrammopes* Cambridge (Uloboridae). *Journal of the Asiatic Society of Bengal*, 213: 172-177.

Tikader, B.K. 1977. Studies on spider fauna of Andaman and Nicobar Islands, Indian Ocean. *Records of the Zoological Survey of India*, 72: 153-212.

Tikader, B.K. 1981a. Studies on spiders of the genus *Lutica* Marx (Family: Zodariidae) from India. *Journal of the Bombay Natural History Society*, 78: 139-142.

Tikader, B.K. 1981b. A new species of rare spiders of the genus *Hyptiotes* (Family: Uloboridae) from India. *Current Science*, 50: 154-155.

Tikader, B.K. 1982. The Fauna of India, Spiders : Araneae, Part 1 Family Araneidae (= Argiopidae) Typical Orb-Weavers, pp.1-293; Part 2 Family Gnaphosidae, *Zoological Survey of India*, Kolkata, pp. 295-536.

Tikader, B.K. & Biswas, B. 1981. Spider fauna of Calcutta and vicinity: Part-I. *Records of the Zoological Survey of India, Occasional Paper*, 30: 1-149.

Tikader, B.K. & Gajbe, U.A. 1973. A new species of spider of genus *Plator* Simon (Family-Platoridae) from India. *Current Science*, 42: 829.

Tikader, B.K. & Gajbe, U.A. 1976a. A new species of spider of the genus *Plator* Simon (Family-Platoridae) from Almora, India. *Journal of the Bombay Natural History Society*, 73: 178-179.

Tikader, B.K. & Gajbe, U.A. 1976b. A new species of spider of the genus *Plator* Simon (Family: Platoridae) from India. *Journal of the Bombay Natural History Society*, 72: 797-799.

Tikader, B.K. & Malhotra, M.S. 1976. A new species of spider of the genus *Lutica* (Family Zodariidae) from India. *Journal of the Bombay Natural History Society*, 72: 794-796.

Tikader, B.K. & Patel, B.H. 1975. Studies on some rare spiders of the family Zodariidae from India. *Bulletin of the British Arachnological Society*, 3(5): 137-139.

Tiwari, A.K. & Singh, R. 2021. Diversity and distribution of Pisauridae (Araneae: Araneomorphae: Arachnida) in India. *International Journal of Entomology Research*, 6(1): 119-125.

Tiwari, A.K., Singh, G. & Singh, R. 2021a. Biodiversity of some poorly known families of spiders (Areneomorphae: Araneae: Arachnida) in India. *Journal of Global Biosciences*, 10(1): 8352-8371.

Tiwari, A.K., Singh, G. & Singh, R. 2021b. Faunal diversity of Oonopidae (Araneomorphae: Araneae: Arachnida) in India. *Journal of Global Biosciences*, 10(1): 8340-8351.

Umarani, S. & Umamaheshwari, S. 2013. Diversity of spider fauna at different sites in Palani Hills, Dindigul district, Tamilnadu, SouthIndia. *International Journal of Advanced Biological Research*, 3(4): 535-539.

Uniyal, V.P. & Hore, U. 2009. *Effect of management practices on spider diversity in Terai Conservation Area (TCA)*. Final Project Report, Wild Life Institute of India. 222 pp.

Uniyal, V.P., Sivakumar, K. & Quasin, S. 2011. *Diversity of spiders in Nanda Devi Biosphere Reserve. Wildlife Institute of India, Dehradun*. DST Project Completion Report, 199 pp.

World Spider Catalog 2021. *World Spider Catalog*. Version 22.0. Natural History Museum Bern, online at http://wsc.nmbe.ch, accessed on 30 April 2021.

Yadav, A. 2019. Diversity and ecology of spiders in Champaner-Pavagadh Archaeological Park, a world heritage site in Gujarat. Ph.D. Thesis, The Maharaja Sayajirao University of Baroda, Vadodara, Maharashtra, India.

Yadav, A., Solanki, R., Siliwal, M. & Kumar, D. 2017. Spiders of Gujarat: a preliminary checklist. *Journal of Threatened Taxa*, 9(9): 10697-10716.

Serket (2021) vol. 17(4): 394-399.

Orb-Web spiders (Arachnida: Araneae) of Maharashtra State, India

Pawan U. Gajbe
Department of Zoology, Shri Mathuradas Mohota College of Science, Nagpur - 440024, Maharashtra, India
E-mail address: pgajbe884@gmail.com

Abstract

Orb web spiders, a familiar feature of terrestrial ecosystems, are much admired for their intricate spiral wheel-shaped webs. Maharashtra is a State occupying the Central and Western regions of India. A checklist of the orb web spiders of Maharashtra has been prepared, which consists of 73 species in 24 genera of two families, Araneidae and Tetragnathidae. Of these, 61 species in 19 genera belong to family Araneidae and 12 species in 5 genera belong to family Tetragnathidae.

Keywords: Araneidae, Tetragnathidae, orb weaver, biodiversity, fauna, India.

Introduction

Spiders are an integral part of terrestrial ecosystems. Research into spider biology, particularly the diversity of silk, webs, and venoms, together with the associated ecology and behaviours, has greatly increased in recent decades (Gillespie & Spagna, 2009). Web-building spiders are forming an important model system to address questions in a variety of biological fields. They are attractive because of their intriguing biology and because they can be fairly easily collected and maintained in the laboratory (Zschokke & Herberstein, 2005). Orb web spiders are ubiquitous predators in terrestrial ecosystems. They are classified in two families of Araneae, namely Araneidae Clerck, 1757 and Tetragnathidae Menge, 1866. The common orb weavers belong to Araneidae, whereas, orb weavers belonging to Tetragnathidae are commonly known as long-jawed orb weavers on account of their long chelicerae. Orb webs are composite structures built from multiple types of silk, each with its own unique molecular structure and mechanical

function, such that orb webs also link together evolutionary research from the genes coding for silk proteins to whole web function in the environment (Blackledge *et al.*, 2011). In nature, orb-web spinning spiders are often observed residing on the hub of their web, facing down. Maximizing the amount of prey caught on the web in the long term corresponds to maximizing the area of the region. The orientation that maximizes this area is shown to be downwards (Maciejewski, 2010).

Presently, 49368 species of spiders in 4183 genera of 129 families are known from the world. These include 3059 species in 177 genera of family Araneidae and 988 species in 50 genera of family Tetragnathidae (World Spider Catalog, 2021). Maharashtra is one of the largest states in India and is home to the Western Ghats, one of the world's most important biodiversity hotspots. Despite being rich in spider diversity, not many research studies have been conducted documenting the orb weavers of Maharashtra. In order to augment the knowledge of biodiversity of Maharashtra and to give impetus to research work on orb-web spiders, a checklist of the orb web spiders of Maharashtra belonging to families Araneidae and Tetragnathidae has been provided here.

Material and Methods

Maharashtra State occupies the western peninsular region of India. It covers an area of 307713 km^2 and is the third largest state in India. Arabian Sea lies to the west of Maharashtra. The Western Ghats are located at the western border of the State. The checklist of orb-web spiders of Maharashtra has been prepared by collecting research papers, books and chapters in edited books available in print and/or online, pertaining to the spider fauna of Maharashtra. Scientific names of spiders and classification are as per the World Spider Catalog (2021).

Results

The orb-web spider fauna of Maharashtra includes 73 species in 24 genera of families Araneidae and Tetragnathidae (Table 1). As many as 61 species in 19 genera belong to Araneidae and 12 species in 5 genera belong to Tetragnathidae. Nine species, namely, *Argiope aemula*, *Cyrtophora cicatrosa*, *Cyrtophora citricola*, *Leucauge decorata*, *Neoscona mukerjei*, *Neoscona nautica*, *Neoscona theisi*, *Nephila pilipes*, *Tetragnatha bengalensis*, have been recorded by the author from Nagpur district of Maharashtra (Gajbe, 2015, 2016). The pictures of some orb weavers found in Maharashtra are depicted in Fig. (1).

Table 1. Checklist of Orb-Web spiders of Maharashtra.

No.	Species	References
	Family Araneidae (Common Orb Weavers)	
1	*Araneus bilunifer* Pocock, 1900	Bastawade & Khandal, 2006; Meshram, 2011
2	*Araneus ellipticus* (Tikader & Bal, 1981)	Bastawade & Khandal, 2006; Tikader, 1982
3	*Araneus mitificus* (Simon, 1886)	Bastawade & Khandal, 2006; Deshmukh & Chaudhari, 2016; Meshram, 2011; Misal *et al.*, 2019; Tikader, 1974, 1982; Warghat *et al.*, 2011
4	*Araneus panchganiensis* Tikader and Bal, 1981	Tikader, 1982
5	*Araniella cucurbitina* (Clerck, 1757)	Meshram, 2011; Warghat *et al.*, 2011
6	*Argiope aemula* (Walckenaer, 1841)	Bastawade, 2004, 2006; Bastawade & Khandal,

		2006; Gajbe, 2015, 2016; Maheshwari *et al*., 2018; Meshram, 2011; Misal *et al*., 2019; Tikader, 1982; Warghat *et al*., 2011
7	*Argiope anasuja* Thorell, 1887	Bhandarkar & Paliwal, 2019; Maheshwari *et al*., 2018; Misal *et al*., 2019; Tikader, 1982
8	*Argiope catenulata* (Doleschall, 1859)	Maheshwari *et al*., 2018
9	*Argiope lobata* (Pallas, 1772)	Tikader, 1974 [as *Argiope arcuata* Simon, 1884]
10	*Argiope pulchella* Thorell, 1881	Bastawade & Khandal, 2006; Tikader, 1974, 1982
11	*Argiope trifasciata* (Forsskål, 1775)	Bastawade, 2004, 2006; Warghat *et al*., 2011
12	*Chorizopes anjanes* Tikader, 1965	Tikader, 1974, 1982
13	*Chorizopes khanjanes* Tikader, 1965	Meshram, 2011; Tikader, 1974, 1982
14	*Cyclosa bifida* (Doleschall, 1859)	Meshram, 2011
15	*Cyclosa confraga* (Thorell, 1892)	Misal *et al*., 2019; Tikader, 1974, 1982
16	*Cyclosa hexatuberculata* Tikader, 1982	Bastawade, 2004, 2006; Deshmukh & Chaudhari, 2016; Tikader, 1982; Warghat *et al*., 2011
17	*Cyclosa insulana* (Costa, 1834)	Tikader, 1974; Warghat *et al*., 2011
18	*Cyclosa moonduensis* Tikader, 1963	Bastawade, 2004; Deshmukh & Chaudhari, 2016; Meshram, 2011; Tikader, 1974, 1982; Warghat *et al*., 2011
19	*Cyclosa mulmeinensis* (Thorell, 1887)	Tikader, 1974, 1982
20	*Cyclosa simoni* Tikader, 1982	Deshmukh & Chaudhari, 2016
21	*Cyclosa spirifera* Simon, 1889	Warghat *et al*., 2011
22	*Cyrtarachne biswamoyi* Tikader, 1961	Bastawade & Khandal, 2006
23	*Cyrtarachne promilai* Tikader, 1963	Tikader, 1974, 1982
24	*Cyrtarachne raniceps* Pocock, 1900	Bastawade & Khandal, 2006; Tikader, 1974
25	*Cyrtarachne sundari* Tikader, 1963	Tikader, 1974, 1982
26	*Cyrtophora bidenta* Tikader, 1970	Meshram, 2011
27	*Cyrtophora cicatrosa* (Stoliczka, 1869)	Bastawade, 2006; Bastawade & Khandal, 2006; Gajbe, 2015; Meshram, 2011; Tikader, 1974, 1982
28	*Cyrtophora citricola* (Forsskål, 1775)	Bastawade & Khandal, 2006; Gajbe, 2016; Meshram, 2011; Tikader, 1974, 1982; Warghat *et al*., 2011
29	*Cyrtophora moluccensis* (Doleschall, 1857)	Maheshwari *et al*., 2018; Meshram, 2011
30	*Eriovixia excelsa* (Simon, 1889)	Bastawade, 2004; Meshram, 2011; Tikader, 1982; Warghat *et al*., 2011
31	*Eriovixia laglaizei* (Simon, 1877)	Bastawade, 2004, 2005; Bastawade & Khandal, 2006; Meshram, 2011
32	*Eriovixia poonaensis* (Tikader & Bal, 1981)	Bastawade & Khandal, 2006; Tikader, 1982
33	*Gasteracantha cancriformis* (Linnaeus, 1758)	Bastawade & Khandal, 2006; Tikader, 1982
34	*Gasteracantha geminata* (Fabricius, 1798)	Bastawade & Khandal, 2006; Tikader, 1974
35	*Gasteracantha kuhli* C.L. Koch, 1837	Tikader, 1974
36	*Gasteracantha remifera* Butler, 1873	Bastawade & Khandal, 2006; Tikader, 1982
37	*Gea subarmata* Thorell, 1890	Bastawade, 2006; Maheshwari *et al*., 2018
38	*Herennia multipuncta* (Doleschall, 1859)	Bastawade & Khandal, 2006; Tikader, 1974 [as *Herennia ornatissima* (Doleschall, 1859)]
39	*Larinia chloris* (Savigny, 1825)	Meshram, 2011; Tikader, 1982
40	*Macracantha hasselti* (C.L. Koch, 1837)	Bastawade & Khandal, 2006 [as *Gasteracantha hasselti*]

41	*Neoscona bengalensis* Tikader & Bal, 1981	Chapke & Raja, 2015; Maheshwari *et al*., 2018; Meshram, 2011; Misal *et al*., 2019
42	*Neoscona chrysanthusi* Tikader & Bal, 1981	Chapke & Raja, 2015; Meshram, 2011
43	*Neoscona molemensis* Tikader & Bal, 1981	Meshram, 2011
44	*Neoscona mukerjei* Tikader, 1980	Bastawade, 2004, 2005, 2006; Bastawade & Khandal, 2006; Chapke & Raja, 2015; Gajbe, 2015; Maheshwari *et al*., 2018; Meshram, 2011; Warghat *et al*., 2011
45	*Neoscona nautica* (L. Koch, 1875)	Bastawade, 2006; Chapke & Raja, 2015; Gajbe, 2015, 2016; Meshram, 2011; Warghat *et al*., 2011
46	*Neoscona odites* (Simon, 1906)	Chapke & Raja, 2015; Meshram, 2011
47	*Neoscona pavida* (Simon, 1906)	Chapke & Raja, 2015; Meshram, 2011
48	*Neoscona punctigera* (Doleschall, 1857)	Bastawade, 2004; Bastawade & Khandal, 2006; Chapke & Raja, 2015; Meshram, 2011
49	*Neoscona shillongensis* Tikader & Bal, 1981	Chapke & Raja, 2015; Meshram, 2011
50	*Neoscona sinhagadensis* (Tikader, 1975)	Bhandarkar & Paliwal, 2019; Chapke & Raja, 2015; Tikader, 1982
51	*Neoscona theisi* (Walckenaer, 1841)	Bastawade, 2004, 2005, 2006; Bastawade & Khandal, 2006; Chapke & Raja, 2015; Deshmukh & Chaudhari, 2016; Gajbe, 2016; Warghat *et al*., 2011
52	*Neoscona vigilans* (Blackwall, 1865)	Chapke & Raja, 2015; Meshram, 2011; Tikader, 1974; Warghat *et al*., 2011
53	*Nephila pilipes* (Fabricius, 1793)	Bastawade, 2004, 2005, 2006; Bastawade & Khandal, 2006; Gajbe, 2015, 2016; Maheshwari *et al*., 2018; Tikader, 1974, 1982
54	*Nephilengys malabarensis* (Walckenaer, 1841)	Bastawade & Khandal, 2006; Maheshwari *et al*., 2018; Tikader, 1982
55	*Ordgarius hobsoni* (O. Pickard-Cambridge, 1877)	Bastawade & Khandal, 2006; Tikader, 1974, 1982
56	*Ordgarius sexspinosus* (Thorell, 1894)	Tikader, 1974, 1982
57	*Parawixia dehaani* (Doleschall, 1859)	Bastawade & Khandal, 2006; Maheshwari *et al*., 2018
58	*Poltys godrejii* Bastawade & Khandal, 2006	Bastawade & Khandal, 2006
59	*Poltys nagpurensis* Tikader, 1982	Tikader, 1982; Warghat *et al*., 2011
60	*Poltys rehmanii* Bastawade & Khandal, 2006	Bastawade & Khandal, 2006
61	*Thelacantha brevispina* (Doleschall, 1857)	Tikader, 1974; Maheshwari *et al*., 2018
	Family Tetragnathidae (Long-Jawed Orb Weavers)	
62	*Guizygiella indica* (Tikader and Bal, 1980)	Bastawade, 2006; Meshram, 2011; Warghat *et al*., 2011 [as *Zygiella indica*]
63	*Guizygiella melanocrania* (Thorell, 1887)	Bastawade, 2006; Meshram, 2011
64	*Leucauge celebesiana* (Walckenaer, 1841)	Tikader, 1974, 1982
65	*Leucauge decorata* (Blackwall, 1864)	Bastawade, 2004, 2005, 2006; Bastawade & Khandal, 2006; Bhandarkar & Paliwal, 2019;

		Gajbe, 2015, 2016; Maheshwari *et al*., 2018; Meshram, 2011; Tikader. 1974; Warghat *et al*., 2011
66	*Leucauge dorsotuberculata* Tikader, 1982	Bastawade & Khandal, 2006; Tikader, 1982
67	*Leucauge tessellata* (Thorell, 1887)	Bastawade & Khandal, 2006
68	*Opadometa fastigata* (Simon, 1877)	Bastawade & Khandal, 2006; Warghat *et al*., 2011
69	*Tetragnatha bengalensis* Walckenaer, 1841	Gajbe, 2016
70	*Tetragnatha geniculata* Karsch, 1892	Tikader, 1974
71	*Tetragnatha javana* (Thorell, 1890)	Tikader, 1974
72	*Tetragnatha mandibulata* Walckenaer, 1841	Bastawade, 2004, 2005, 2006; Bastawade & Khandal, 2006; Maheshwari *et al*., 2018; Meshram, 2011; Tikader, 1974; Warghat *et al*., 2011
73	*Tylorida ventralis* (Thorell, 1877)	Bastawade, 2004 [as *Leucauge pondae* Tikader, 1970]

Fig. 1. (A) *Araneus mitificus*, (B) *Argiope aemula*, (C) *Neoscona nautica*, (D) *Neoscona theisi*, (E) *Argiope anasuja*, (F) *Nephila pilipes*, (G) *Leucauge decorata*, (H) *Tetragnatha bengalensis*.

Acknowledgments

I wish to express my thanks to the Principal, S.M. Mohota College of Science, Nagpur, for facilities.

References

Bastawade, D.B. 2004. Araneae. In: *Conservation Area Series 20: Fauna of Pench National Park (Maharashtra)*. pp. 285-312. Zoological Survey of India, Kolkata.

Bastawade, D.B. 2005. Arachnida : Araneae (Spiders). In: *Conservation Area Series 24: Fauna of Melghat Tiger Reserve*. pp. 421-435. Zoological Survey of India, Kolkata.

Bastawade, D.B. 2006. Araneae. In: *Conservation Area Series 25: Fauna of Tadoba-Andhari Tiger Reserve (Maharashtra)*. pp. 283-309. Zoological Survey of India, Kolkata.

Bastawade, D.B. & Khandal, D. 2006. Araneae. *Conservation Area Series 26: Invertebrate Fauna of Sanjay Gandhi National Park, Borivali, Mumbai*. pp. 139-184. Zoological Survey of India, Kolkata.

Bhandarkar, S.V. & Paliwal, G.T. 2019. First distribution record of spider fauna (Arachnida: Araneae) in Navegaon National Park (NNTR) Gondia Maharashtra. *European Journal of Biotechnology and Bioscience*, 7(1): 1-4.

Blackledge, T.A., Kuntner, M. & Agnarsson, I. 2011. The form and function of spider orb webs: evolution from silk to ecosystems. *Advances in Insect Physiology*, 41: 175-262.

Chapke, S. & Raja, I.A. 2015. The spider diversity of the genus, *Neoscona* from Akola region of Maharashtra. *Bioscience Biotechnology Research Communications*, 8(2): 204-207.

Deshmukh, U.S. & Chaudhari, P.W. 2016. Study of spider fauna from orange agro ecosystem in the catchment area of upper Wardha dam, Amravati, Maharashtra, India. *International Journal of Fauna and Biological Studies*, 3(5): 120-123.

Gajbe, P.U. 2015. Record of some spiders (Arachnida: Araneae) found in Ghodazari, Chandrapur District, Maharashtra. *International Journal of Researches in Biosciences, Agriculture & Technology*, Special Issue 6: 133-138.

Gajbe, P.U. 2016. Record of some spiders (Arachnida: Araneae) from Karhandla in Nagpur District, Maharashtra. *Journal on New Biological Reports*, 5(3): 133-138.

Gillespie, R.G. & Spagna, J.C. 2009. Spiders. In: *Encyclopedia of Insects (Second Edition)*. pp. 941-951. Academic Press, Cambridge, Massachusetts.

Maciejewski, W. 2010. An analysis of the orientation of an orb-web spider. *Journal of Theoretical Biology*, 265(4): 604-608.

Maheshwari, N.R., Patil, S.R. & Chopda, M.Z. 2018. Spider Fauna from North Maharashtra, India. *Flora and Fauna*, 24(1): 163-173.

Meshram, A. 2011. Spiders (Arachnida: Araneae) from Toranmal Sanctuary, Maharashtra, India. *E-International Scientific Research Journal*, 3(4): 1-9.

Misal, P.K., Bendre, N.N., Pawar, P.A., Bhoite, S.H. & Deshpande, V.Y. 2019. An updated review on the spiders of Order Araneae from the districts of Western Ghats of India. *Bioscience Biotechnology Research Communications*, 12(4): 855-864.

Tikader, B.K. 1974. *Gazetteer of India, Maharashtra State Fauna, Chapter 4: Spiders*. pp. 508-524. Published by Government of Maharashtra.

Tikader, B.K. 1982. *The Fauna of India, Spiders : Araneae, Family Araneidae (Argiopidae) Typical Orb Weavers, Volume 2, Part 1*. Zoological Survey of India, Kolkata, 293 pp.

Warghat, N.E., Gaur, A.J., Sharma, N.R., Chirde, S.G. & Chandrakar, M.R. 2011. Spiders (Araneae) from Agricultural fields near foothill of Satpura Mountain ranges of Amravati District, Maharashtra, India. *Nature Precedings*.

World Spider Catalog 2021. *World Spider Catalog*. Version 22.0. Natural History Museum Bern, online at http://wsc.nmbe.ch, accessed on April 2021.

Zschokke, S. & Herberstein, M.E. 2005. Laboratory methods for maintaining and studying web-building spiders. *Journal of Arachnology*, 33(2): 205-213.

Serket (2021) vol. 17(4): 400-405.

Spider fauna of some wetlands of Visnagar (Gujarat, India)

Bhavesh M. Parmar
Central laboratory, Dudheswar waterworks, Ahmedabad Municipal Corporation, Gujarat, India
E-mail address: parmarbhaveshkumar@gmail.com

Abstract

This study documents the diversity of spider fauna from the wetlands of Visnagar Taluka, which fall under the Mahesana District, Gujarat. The survey of spiders was done from 2016 to 2018, using a combination of collecting methods. A total of 97 species and 62 genera of 16 families were identified. Araneidae and Salticidae were the most numerical dominant families through followed by Thomisidae, Lycosidae, and Oxyopidae. Wetland Spiders of Visnagar were demonstrating a total of 26.67% of the total families documented in India.

Keywords: Spiders, wetland, Diversity, Visnagar, Gujarat, India.

Introduction

Spiders (order Araneae) play important role in every terrestrial ecosystem as prey or predator. As this important role, they play a predator role in the regulation of insects and other small animals and as prey, they are the food of lizards and birds like predators. In this way, spiders have an important place in the ecosystem of wetlands.

Statistically, the order Araneae consists of a total of 49368 species and 4183 genera of 129 families worldwide (World Spider Catalog, 2021). A total of 1686 species and 438 genera of 60 families of spiders were recorded from India, (Keswani *et al.*, 2012) and 415 species and 169 genera of 40 families were recorded from Gujarat (Yadav *et al.*, 2017). The present survey of spider fauna provides reference data for future study on the biology of spider fauna.

Material and Methods

Study Area

Visnagar Taluka is situated in Mahesana District. It lies at 23°41'60"N, 72°32'60"E. The climate of the study area is uneven rainfall average 700 to 1000 mm; winter is very cold and summer is very hot. Visnagar Taluka consists of many freshwater ponds and lake-like structures. A total of five ponds "Talav" (Talav Nr Javaleswar Mahadev Tample, Iyasara Talav, Paladi Talav, Dadiya Talav, Kansa Talav) were selected as study sites (Table 1).

Methodology

The spider sampling was done through hand-picking, pitfall, aerial and ground hand collection methods. All collected samples were transferred in 75% ethyl alcohol contain vials for preservation in the laboratory. Collected samples were identified by a stereo zoom microscope and identified up to the genus/species level using various taxonomic literature. (Gajbe, 2007; Parmar, 2013, 2018a,b; Patel, 1972, 1973, 1975; Pocock, 1900; Sebastian & Peter, 2009; Tikader, 1977, 1980, 1982, 1987; Tikader & Biswas, 1981; Tikader & Malhotra, 1980).

Table 1. Geographical locations of study sites.

No.	Site name	Geographical location
1	Iyasara Talav	23°71'93"N, 72°49'41"E
2	Paladi Talav	23°73'87"N, 72°55'79"E
3	Dadiya Talav	23°70'46"N, 72°55'15"E
4	Kansa Talav	23°71'01"N, 72°51'40"E
5	Talav Nr Javaleswar Mahadev Tample	23°69'03"N, 72°55'84"E

Results

Out of 1775 samples, 97 species were identified from the study area from July 2016 to June 2018 (Table 2). The family Araneidae was numerically dominant with 24 species followed by Salticidae (17), Thomisidae (10), Tetragnathidae (8), and Lycosidae (7). Most of the other families had less than 7 species. A total of eight guilds (Table 3) were noted during the study, which are ground runner, orb web builder, foliage hunter, snare/sheet web builder, foliage runner, ambusher, scattered line weaver, and foliage weaver. The species contribution percentage with numbers of genera and species are shown in table (4).

Diversity and community composition

Family Diversity: Inclusive 16 families documented from the study area, which represents 40% of total families from Gujarat (Yadav *et al.*, 2017), 26.67% of the total from India (Keswani *et al.*, 2012)**,** and 12.4% of the total from the World (World Spider Catalog, 2021).

Generic Diversity: A total of 62 genera noted from the study area is representing 14.15% of total genera from India.

Species Diversity: A total of 97 species is documented from the study area representing 23.37% of total species from Gujarat.

Table 2. Spiders collected from various sites.

No.	Family	Genus / Species	S1	S2	S3	S4	S5
1	ARANEIDAE	*Arachnura angura*	+	-	-	-	-
2		*Araneus bilunifer*	+	+	-	-	-
3		*Araneus mitificus*	+	+	-	-	-
4		*Araneus* sp.	+	-	-	-	-
5		*Argiope anasuja*	+	+	+	+	+
6		*Argiope pulchella*	-	+	-	-	-
7		*Chorizopes stoliczkae*	+	-	-	-	-
8		*Cyclosa bifida*	+	+	+	+	+
9		*Cyclosa confraga*	+	+	+	+	+
10		*Cyrtophora cicatrosa*	+	+	+	+	+
11		*Cyrtophora citricola*	+	+	+	+	+
12		*Eriophora* sp.	+	+	+	+	+
13		*Eriovixia excelsa*	+	+	+	+	+
14		*Eriovixia laglaizei*	+	+	+	+	+
15		*Larinia chloris*	+	+	+	+	+
16		*Larinia phthisica*	+	-	-	+	+
17		*Neoscona achine*	+	-	-	+	+
18		*Neoscona biswasi*	+	-	-	+	+
19		*Neoscona mukerjei*	+	+	+	+	+
20		*Neoscona nautica*	+	+	+	+	+
21		*Neoscona odites*	+	+	+	+	+
22		*Neoscona theisi*	+	+	+	+	+
23		*Neoscona* sp.	+	+	+	+	+
24		*Poltys* sp.	-	+	-	+	-
25	CHEIRACANTHIIDAE	*Cheiracanthium* sp.1	-	+	+	-	+
26		*Cheiracanthium* sp.2	-	+	-	+	-
27	CLUBIONIDAE	*Clubiona drassodes*	+	+	-	-	+
28	CORINNIDAE	*Castianeira tinae*	+	+	+	+	-
29		*Castianeira* sp.	+	+	-	-	+
30	ERESIDAE	*Stegodyphus sarasinorum*	-	+	+	-	-
31	GNAPHOSIDAE	*Gnaphosa stoliczkai*	+	+	-	+	-
32		*Poecilochroa* sp.	-	+	-	-	-
33		*Zelotes* sp.	+	+	-	-	-
34	HERSILIIDAE	*Hersilia savignyi*	+	+	+	+	+
35		*Hersilia striata*	+	+	-	-	+
36		*Hersilia* sp.	-	+	-	-	+
37	LYCOSIDAE	*Acantholycosa* sp.	-	+	+	+	+
38		*Arctosa indica*	-	+	+	+	-
39		*Hippasa agelenoides*	-	+	+	+	+
40		*Lycosa poonaensis*	-	+	+	+	-
41		*Lycosa tista*	-	+	+	+	+
42		*Lycosa* sp.	+	+	+	-	-
43		*Pardosa birmanica*	+	+	+	-	-
44	OXYOPIDAE	*Oxyopes bharatae*	+	+	+	+	+
45		*Oxyopes javanus*	+	+	+	+	+
46		*Oxyopes* sp.	+	+	+	+	+

47		*Peucetia elegans*	+	+	-	-	+
48	PHOLCIDAE	*Crossopriza lyoni*	+	+	+	+	+
49		*Pholcus phalangioides*	+	+	+	+	+
50	SALTICIDAE	*Carrhotus viduus*	+	+	+	+	-
51		*Chrysilla lauta*	+	+	-	-	-
52		*Epeus indicus*	+	+	-	-	-
53		*Epocilla aurantiaca*	+	+	-	-	+
54		*Hasarius adansoni*	+	+	+	-	-
55		*Hyllus semicupreus*	+	+	-	+	-
56		*Menemerus bivittatus*	+	+	+	-	-
57		*Menemerus fulvus*	+	+	+	+	+
58		*Myrmaplata plataleoides*	+	+	-	-	+
59		*Myrmarachne* sp.	+	+	-	-	-
60		*Phintella vittata*	+	+	+	+	+
61		*Phintella* sp.	+	+	-	-	-
62		*Phlegra dhakuriensis*	+	+	-	+	-
63		*Plexippus paykulli*	+	+	+	+	+
64		*Stenaelurillus lesserti*	+	+	+	+	-
65		*Telamonia dimidiata*	+	+	-	-	-
66		*Thyene imperialis*	+	+	-	+	+
67	SPARASSIDAE	*Heteropoda bhaikakai*	+	+	+	+	+
68		*Heteropoda venatoria*	+	+	+	+	+
69		*Olios milleti*	+	+	-	+	-
70		*Olios stimulator*	+	+	+	+	+
71		*Olios* sp.	-	-	+	-	+
72	TETRAGNATHIDAE	*Guizygiella indica*	+	+	+	-	-
73		*Guizygiella melanocrania*	+	+	-	+	-
74		*Leucauge decorata*	+	+	+	+	+
75		*Tetragnatha extensa*	+	+	-	+	-
76		*Tetragnatha keyserlingi*	+	+	-	-	-
77		*Tetragnatha mandibulata*	+	+	-	-	-
78		*Tetragnatha* sp.	+	+	-	-	-
79		*Tylorida ventralis*	+	+	+	+	+
80	THERIDIIDAE	*Argyrodes argentatus*	+	+	+	+	+
81		*Argyrodes flavescens*	+	+	+	+	+
82		*Chrysso angula*	+	+	+	+	+
83		*Parasteatoda tepidariorum*	-	+	-	-	-
84		*Steatoda grossa*	-	+	+	+	+
85		*Theridion* sp.	-	+	+	+	+
86	THOMISIDAE	*Indoxysticus minutus*	+	+	-	-	-
87		*Misumena* sp.	+	-	-	-	-
88		*Oxytate* sp.	+	+	-	-	-
89		*Runcinia* sp.	+	-	-	-	-
90		*Synema decoratum*	+	-	-	-	-
91		*Thomisus lobosus*	+	-	-	-	-
92		*Thomisus projectus*	+	-	-	-	-
93		*Thomisus* sp.	+	-	-	-	-
94		*Xysticus kali*	+	-	-	-	-

95		*Xysticus* sp.	+	-	-	-	-
96	ULOBORIDAE	*Uloborus krishnae*	+	+	-	-	-
97		*Uloborus plumipes*	+	+	-	+	+
		Total	81	82	49	54	50

[Site 1 = Iyasara Talav, Site 2 = Paladi Talav, Site 3 = Dadiya Talav, Site 4 = Kansa Talav, Site 5 = Talav Nr Javaleswar Mahadev Tample, S = Site, + = Present, - = Absent]

Table 3. Spider's families common names and guilds.

No.	Family	Common name	Guild
1	Araneidae	Orb-Weavers	Orb web builder
2	Cheiracanthiidae	Long-legged sac spiders	Foliage runner
3	Clubionidae	Leaf-curling sac spiders	Foliage hunter
4	Corinnidae	Sac spiders	Ground runner
5	Eresidae	Velvet spiders	Snare/sheet web builder
6	Gnaphosidae	Flat-bellied ground spiders	Ground runner
7	Hersiliidae	Two-tailed spiders	Foliage hunter
8	Lycosidae	Wolf spiders	Ground runner
9	Oxyopidae	Lynx spiders	Foliage runner
10	Pholcidae	Cellar or Daddy long legs spiders	Scattered line weaver
11	Salticidae	Jumping spiders	Foliage runner
12	Sparassidae	Huntsman spiders	Ground runner
13	Tetragnathidae	Long jawed orb weavers	Orb web builder
14	Theridiidae	Cob web weavers	Scattered line weaver
15	Thomisidae	Crab spiders	Ambusher
16	Uloboridae	Hackled-Orb-web spiders	Orb web builder

Table 4. Species contribution percentage.

No.	Family	No. of genera	No. of species	Species Percentage %
1	Araneidae	11	24	24.74
2	Cheiracanthiidae	1	2	2.06
3	Clubionidae	1	1	1.03
4	Corinnidae	1	2	2.06
5	Eresidae	1	1	1.03
6	Gnaphosidae	3	3	3.09
7	Hersiliidae	1	3	3.09
8	Lycosidae	5	7	7.22
9	Oxyopidae	2	4	4.12
10	Pholcidae	2	2	2.06
11	Salticidae	15	17	17.53
12	Sparassidae	2	5	5.15
13	Tetragnathidae	4	8	8.25
14	Theridiidae	5	6	6.18
15	Thomisidae	7	10	10.31
16	Uloboridae	1	2	2.06
Total		62	97	100%

Conclusion

This is the first documentation of spider fauna in wetlands of Northern Gujarat. The diversity at macro and microhabitat levels support large numbers of spider in these wetlands of Visnagar.

A total of 97 spider species was recorded from various wetlands of the study area. In these wetlands, site-2 & site-1 have maximum numbers of spiders recorded. This documentation of spider fauna provides reference data for future study on the biology of spider fauna.

References

Gajbe, U.A. 2007. Araneae: Arachnida. In: *Fauna of Madhya Pradesh (including Chhattisgarh), State Fauna Series*. Zoological Survey of India Kolkata, 15(1): 419-540.

Keswani, S., Hadole, P. & Rajoria, A. 2012. Checklist of spiders (Arachnida: Araneae) from India-2012. *Indian Journal of Arachnology*, 1(1): 1-129.

Parmar, B.M. 2013. *Short term study of spider diversity of Pariej wetland*. M.Sc. dissertation thesis, *S.P.University.*

Parmar, B.M. 2018a. *Taxonomic and Ecological study of Spiders from Satlasana Taluka, Gujarat, India*. Ph.D. Thesis, H.N.G.University.

Parmar, B.M. 2018b. Some Spiders from in and around the Caves of Taranga Hills, Mahesana, Gujarat, India. *Ambient Science*, 5(1): 49-50.

Patel, B.H. 1972. *Studies of spiders fauna (Araneae: Arachnida) from Gujarat*. Ph.D. thesis, S.P. university, Anand.

Patel, B.H. 1973. Some interesting theridiid spiders (Araneae: Theridiidae) from Gujarat, India. *Bulletin of the British Arachnological Society*, 2(8): 149-152.

Patel, B.H. 1975. Some spiders of the families Filistatidae and Scytodidae from Gujarat, India. *Oriental Insects*, 9: 425-429.

Pocock, R.I. 1900**.** *The fauna of British India, including Ceylon and Burma. Arachnida*. Taylor and Francis, London, 279 pp.

Sebastian, P.A. & Peter, K.V. 2009. *Spiders of India*. Universities Press, Hyderabad. 734 pp.

Tikader, B.K. 1977. Studies on spider fauna of Andaman and Nicobar islands, Indian Ocean. *Records of the Zoological Survey of India*, 72: 153-212.

Tikader, B.K. 1980. Thomisidae (Crab-spiders). *The Fauna of India, Araneae*, 1(1): 1-247.

Tikader, B.K. 1982. Family Gnaphosidae. *The Fauna of India. Spiders: Araneae.* 2(2): 295-536.

Tikader, B.K. 1987. *Handbook of Indian Spiders*. Calcutta, Zoological Survey of India, 251 pp.

Tikader, B.K. & Biswas, B. 1981. Spider fauna of Calcutta and vicinity: Part-I. *Records of the Zoological Survey of India, Occasional Paper* 30: 1-149.

Tikader, B.K. & Malhotra, M.S. 1980. Lycosidae (Wolf-spiders). *The Fauna of India, Araneae*, 1(2): 248-447.

World Spider Catalog 2021. *World Spider Catalog*. Version 22.0. Natural History Museum Bern, online at http://wsc.nmbe.ch, accessed on April 2021.

Yadav, A., Solanki, R., Siliwal, M. & Kumar, D. 2017. Spiders of Gujarat: a preliminary checklist. *Journal of Threatened Taxa*, 9(9): 10697-10716.

Serket (2021) vol. 17(4): 406-412.

Synonymization of *Pardosa mysorensis* (Tikader & Mukerji, 1971) with *Pardosa sumatrana* (Thorell, 1890)

Raveendran Sudha Abhijith [1*], Palissery Sheeba [2]
& Ambalaparambil Vasu Sudhikumar [1]

[1] Centre for Animal Taxonomy and Ecology (CATE), Department of Zoology, Christ College (Autonomous), Irinjalakuda, Kerala-680125, India

[2] Department of Zoology, Vimala College (Autonomous), Kerala, India

[*] Corresponding author e-mail address: abhijithrsabhiramam@gmail.com

Abstract

Pardosa is the largest genus in family Lycosidae. Many of the members in this family and genus show morphological similarity and intra-specific variation, which makes their taxonomy difficult. The conclusive method of genitalic analysis was limited in olden days might have resulted in misplacement of various taxa. In this paper, *Pardosa mysorensis* (Tikader & Mukerji, 1971) is synonymized with *Pardosa sumatrana* (Thorell, 1890) based on examination of specimen from southern Indian state of Kerala. Detailed genitalic photographs and habitus images are given.

Keywords: Wolf spiders, Lycosidae, *Pardosa*, synonym, Kerala, India.

Introduction

Lycosidae Sundevall, 1833, wolf spiders, are 6th largest spider family in the world with 2431 species and 125 genera and genus *Pardosa* C.L. Koch, 1847 is the largest group in this family (World Spider Catalog, 2021). Many of the members of genus *Pardosa* show genitalic polymorphism which results in misplacements of them as different species (Jocqué, 2002). Morphologically they are very similar but intra-specific variation also present. So, many of the morphological features are non-informative for species level identification (Wang & Zhang, 2021). The best way of genitalic analysis might be limited in the past and might have resulted in misplacement of many morphologically different individuals under different species. The correction of these

errors will require great effort. The literature survey for these studies revealed about synonymization of so many species with *Pardosa sumatrana* (Thorell, 1890). In our studies themselves, various morphologically different specimens showed similarity in genitalic structures. These all points towards the importance of genitalic analysis of spiders for the classification, especially in families like Lycosidae. In the same time, genitalic polymorphism should be kept in mind. A taxonomist's prime job is to accurately classify an organism, not simply reporting new species.

Material and Methods

All specimens are preserved in 70% ethanol and were studied, photographed and measured using a Leica M205C stereomicroscope, a Leica DFC450 Camera, and LAS software (Ver.4.12). Epigynes dissected and were cleared in potassium hydroxide (KOH) solution. Ocular measurements were taken after placing the specimen dorsally. Leg measurements are shown as: total length (femur, patella and tibia, metatarsus, tarsus). All measurements are given in millimetres (mm).

Abbreviations used in the main text are: ALE = anterior lateral eye, AME = anterior median eye, CATE = Center for Animal Taxonomy and Ecology, CD = copulatory duct, CO = copulatory opening, FD = fertilization duct, PLE = posterior lateral eye, PME = posterior median eye, SS = septal stem.

Taxonomy

Family **Lycosidae** Sundevall, 1833

Genus ***Pardosa*** C.L. Koch, 1847

Pardosa sumatrana Thorell, 1890

Lycosa sumatrana Thorell, 1890, 136 (♂♀); Gravely, 1924, 604, f. 4 C-E (♂♀); Sherriffs, 1939, 137, f. 3.

Pardosa sumatrana Hogg, 1919, 100 (♀); Buchar, 1976, 207, f. 4I-L (♀); Buchar, 1980, 80, f. 1-9, 11-14, 16-26 (♂♀); Tikader & Malhothra, 1980, 353, f. 211-215 (♂♀); Tikader & Biswas, 1981, 56, f. 90-91 (♀); Chen & Gao, 1990, 129, f. 161a-b (♂♀); Okuma *et al.*, 1993, 51, f. 45C (♀); Zhao, 1993, 101, f.41a-b (♂♀); Barrion & Litsinger, 1994, 311, f. 1622-1624 (♀); Barrion & Litsinger, 1995, 382, f. 226a-f, 227a-d (♂♀); Yin *et al.*, 1997, 258, f. 122a-h (♂♀); Yang & Chai, 1998, 63, f. 4a-d (♀); Song *et al.*, 1999, 334, f. 198k (♂♀); Hu, 2001, 203, f. 103.1-4 (♂♀); Biswas & Raychaudhuri, 2003, 119, f. 56-62 (♂♀); Gajbe, 2007, 501, f. 240-244 (♂♀); Yin *et al.*, 2012, 856, f. 429a-h (♂♀); Sen *et al.*, 2015, 50, f. 229-233, pl. 15 (♀); Dhali *et al.*, 2017, 75, f. 374-378, pl. 26 (♀); Tyagi *et al.*, 2019, Supplement, f. S2.30, S3.15-18 (♀); Wang *et al.*, 2021, 50, f. 47A-I, 48A-F (♂♀).

Lycosa chengta Fox, 1935, 453 f. 5 (♀) [synonymized by Chen & Gao, 1990]

Lycosa arorai Dyal, 1935, 140, pl 13, f. 40-41(♂) [synonymized by Barrion & Listinger, 1995]

Arkalosula chengta Roewer, 1955, 231 [Genus transfer from *Lycosa chengta* which is synonymized later]

Chorilycosa arorai Roewer, 1955, 237 [Genus transfer from *Lycosa arorai* which is synonymized later]

Pardosa davidi Schenkel, 1963, 378, f. 219 (♀); Hu, 1984, 235, f. 242-243 (♂♀); Zhao, 1993, 86, f. 36a-c (♂♀) [synonymized by Chen & Gao, 1990]

Lycosa mysorensis Tikader & Mukerji, 1971, 531, f. 1a-b (♀) – ***New synonym***

Pardosa mysorensis Tikader & Malhotra, 1980, 332, f. 168-170 (♀) [transferred from Lycosa] – ***New synonym***

Pardosa shyamae Hu & Li, 1987, 293, f. 25.3-4 (f, misidentified).
Pardosa tieshinglii Barrion *et al.*, 2013, 16, f. 17A-G (♂♀) [synonymized by Wang *et al.*, 2021]
Pardosa villarealae Barrion *et al.*, 2013, 17, f. 18A-E (♂) [synonymized by Wang *et al.*, 2021]

Material examined
INDIA, Kerala: 3 ♀♀ from agricultural lands of Erezha south, Alappuzha 9°22.37'N, 76°51.85'E, alt. 32.81 ft, February 8, 2021, Abhijith (CATE); 4 ♀♀ from Christ College campus, Thrissur, 10°35.57'N, 76°21.32'E, alt. 49.2 ft, January 31, 2021, Abhijith (CATE); 2 ♀♀ from paddy fields of Ochira, Kollam, 9°13.25'N, 76°51.68'E, alt. 29.53ft, December 2, 2020, Abhijith (CATE).

Diagnosis
Only female sex is being discussed here as the proposed junior synonym was described based only on female sex. Females are morphologically similar to other members of *Pardosa*, but, differ in the genitalia structure. The epigyne in ventral view shows an inverted T shaped uniform septal stem (SS). Internally copulatory duct (CD) shows a distinguishable in folding and tip of spermatheca points towards hood. Fertilization duct (FD) resembles a horizontally placed kidney (Fig. 1).

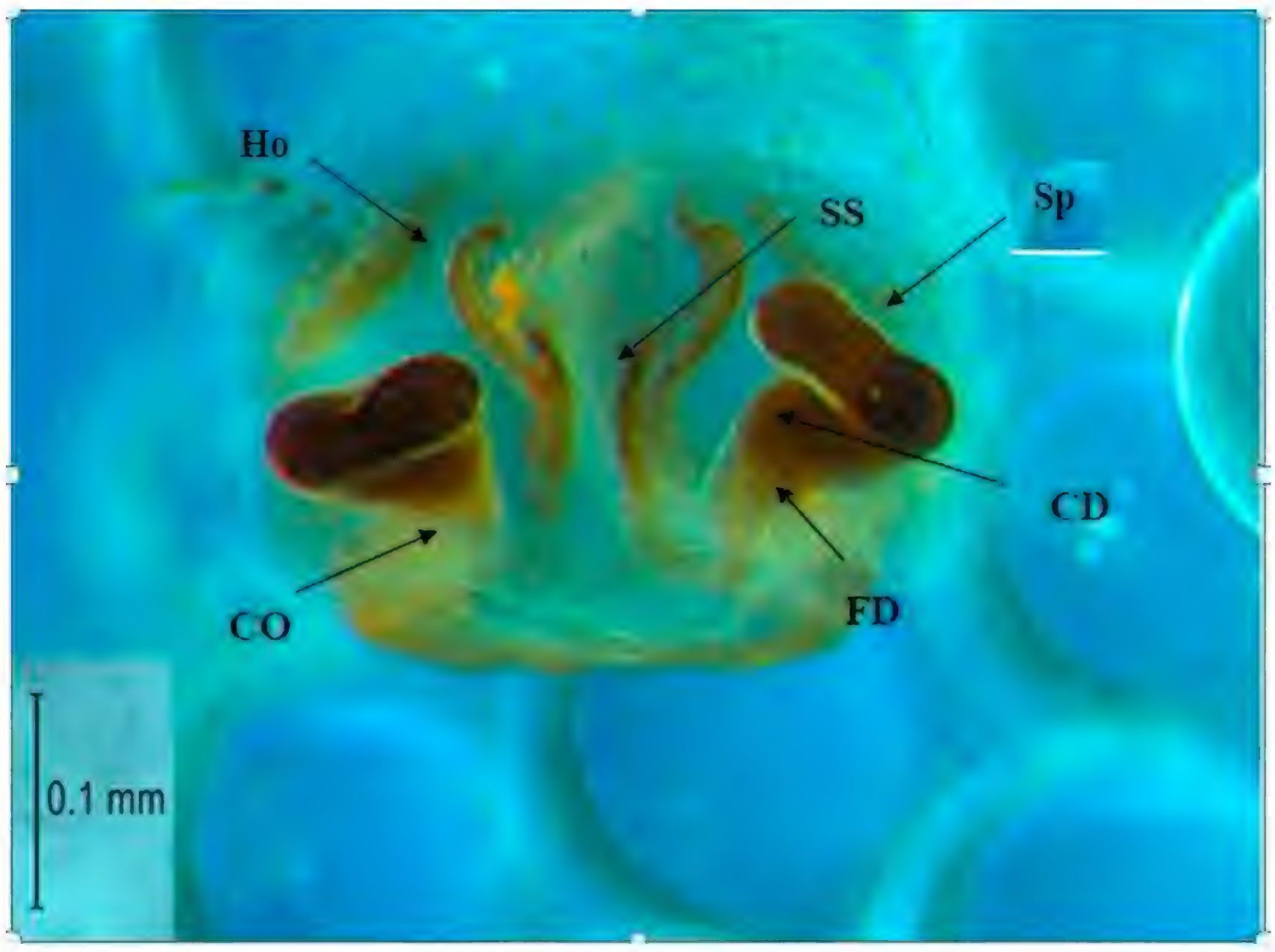


Fig. 1. *Pardosa sumatrana* (Thorell, 1890), female from Erezha south, Alappuzha, Kerala, cleared epigyne dorsal view. Abbreviations: CD = copulatory duct, CO = copulatory opening, FD = fertilization duct, Ho = hood, Sp = spermatheca, SS = septal stem.

Description

Female from Erezha south, Alappuzha (Fig. 2.A-B). Total length 3.72. Prosoma 1.99 long, 1.5 wide. Opisthosoma 1.73 long, 1.14 wide. Carapace yellowish brown with distinct longitudinal fovea. Dark greenish spots along lateral edges of carapace. Median band greenish yellow, broader near ocular area and narrower in thoracic area. Lateral band broad, dark greenish brown colour. Ocular area black and hairy. Head region flanks steep without any projections. Eye sizes and inter-distances: AME 0.087, ALE 0.07, PME 0.216, PLE 0.192, AME-AME 0.117, AME-ALE 0.094, PME-PME 0.383, PME-PLE 0.310. Clypeus height 0.154. Labium longer than wide. Chelicerae has 3 promarginal and 3 retromarginal teeth. Sternum heart shaped, clothed with sparse black hairs. Legs yellow with dark greenish yellow patches. Leg measurements: I 5.60 (1.56, 1.91, 1.26, 0.87); II 5.24 (1.40, 1.85, 1.22, 0.77); III 5.20 (1.43, 1.68, 1.38, 0.71); IV 7.70 (1.87, 2.28, 2.37, 1.18). Leg formula: 4123. Opisthosoma long oval. Dorsum dark yellowish brown with several lateral band like patterns. Ventral side yellow. Posterior spinnerets larger than anterior pair.

Epigyne in ventral view shows inverted T shaped SS (Fig. 2.C-D). In internal view two hoods present at anterior end (Fig. 2.E-F). SS is elongated, narrow throughout except a little broader near hood. Base of septum is elongate than broad. Copulatory opening (CO) near meeting point of base of septum and CD. CD has an interior bend visible as an in-folding. Spermatheca longer than wide and tip positioned towards hood in two dimensional view. FD which placed near CD has an in-folding, resembling a horizontally placed kidney.

Distribution: India, Indonesia, China, Bhutan, Myanmar, Sri Lanka, Philippines, Nepal, Bangladesh (World Spider Catalog, 2021).

Remarks

Pardosa sumatrana is a very common lycosid throughout India and neighbouring countries. Earlier descriptions of the species lack clear pictures or description of genital structures. Other morphological features are not much conclusive in Lycosidae, especially *Pardosa* which shares very similar morphology. Morphological descriptions by Tikader & Malhothra (1980) is similar to our specimens. Epigyne pictures by Tyagi *et al.* (2019) also shows similarity.

Pardosa mysorensis (Tikader & Mukerji, 1971) was described based on single sex and a few specimens. Only two taxonomic references were present on the species collected from a single location (Tikader & Mukerji, 1971, 1980). The original description by Tikader & Mukerji (1971) is similar to the description *of P. sumatrana*. But, epigyne description is absent and figures are obscure and non conclusive. The epigyne pictures by the original author in another publication (Tikader & Malhotra, 1980) shows similarity to epigyne pictures of *P. sumatrana*. SS structure, arrangement of CD and spermathecae are similar to *P. sumatrana*. Other morphological descriptions are also similar. By these comparisons we are confident that *P. mysorensis* was a misidentification and is a junior synonym of *P. sumatrana*. The small variations seen in the epigyne of this species may arise due to genitalic polymorphism as described by Jocqué (2002).

Acknowledgments

We express our deepest gratitude to Principal, Christ College (Autonomous), Irinjalakuda, Kerala for providing laboratory facilities and Junior Research Fellowship

[08/376(0013)EMR-1/2019] of Council of Scientific and Industrial Research (CSIR), Ministry of Science and Technology, Government of India, New Delhi for funding the research. We also express our sincere thanks to Zoological Survey of India (ZSI), Kolkata, India especially Dr. Shelly Acharya, Scientist-E, ZSI, Kolkata for providing type specimen photographs of junior synonym.

Fig. 2. *Pardosa sumatrana* (Thorell, 1890), females from Erezha South, Alappuzha, Kerala. A-B. Habitus. A. dorsal view. B. ventral view. C-F. Epigyne. C-D. ventral view. E-F. dorsal view, cleared. (C and E of the same specimen, D and F from another specimen).

References

Barrion, A.T. & Litsinger, J.A. 1994. Taxonomy of rice insect pests and their arthropod parasites and predators. In: Heinrichs, E.A. (ed.) Biology and Management of Rice Insects. Wiley Eastern, New Delhi, pp. 13-15, 283-359.

Barrion, A.T. & Litsinger, J.A. 1995. *Riceland spiders of South and Southeast Asia*. CAB International, Wallingford, UK, xix + 700 pp.

Barrion, A.T., Barrion-Dupo, A.L.A., Catindig, J.L.A., Villareal M., O., Cai, D., Yuan, Q. H. & Heong, K.L. 2013. New species of spiders (Araneae) from Hainan Island, China. *UPLB Museum Publications in Natural History*, 3: 1-103. [pp. 16-18]

Biswas, V. & Raychaudhuri, D. 2003. Wolf spiders of Bangladesh: genus *Pardosa* C. L. Koch (Araneae: Lycosidae). *Records of the Zoological Survey of India*, 101(1-2): 107-125.

Buchar, J. 1976. Über einige Lycosiden (Araneae) aus Nepal. *Ergebnisse des Forschungsunternehmens Nepal Himalaya*, 5: 201-227.

Buchar, J. 1980. Lycosidae aus dem Nepal-Himalaya. II. Die *Pardosa nebulosa*- und *P. venatrix*-Gruppe (Araneae: Lycosidae: Pardosinae). *Senckenbergiana Biologica*, 61: 77-91.

Chen, X.E. & Gao, J.C. 1990. *The Sichuan farmland spiders in China*. Sichuan Science and Technology Publishing House, Chengdu, 226 pp.

Dhali, D.C., Saha, S. & Raychaudhuri, D. 2017. Litter and ground dwelling spiders (Araneae: Arachnida) of reserve forests of Dooars, West Bengal. *World Scientific News*, 63: 1-242.

Dyal, S. 1935. Fauna of Lahore. 4.–Spiders of Lahore. *Bulletin of the Department of Zoology of the Panjab University*, 1: 119-252, pl. 11-17.

Fox, I. 1935. Chinese spiders of the family Lycosidae. *Journal of the Washington Academy of Sciences*, 25: 451-456.

Gajbe, U.A. 2007. Araneae: Arachnida. In: Fauna of Madhya Pradesh (including Chhattisgarh), State Fauna Series. Zoological Survey of India, Kolkata, 15(1), 419-540.

Gravely, F.H. 1924. Some Indian spiders of the family Lycosidae. *Records of the Indian Museum, Calcutta*, 26: 587-613.

Hogg, H.R. 1919. Spiders collected in Korinchi, West Sumatra by Messrs H. C. Robinson and C. Boden Kloss. *Journal of the Federated Malay States Museums*, 8(3): 81-106.

Hu, J.L. 1984. *The Chinese spiders collected from the fields and the forests*. Tianjin Science and Technology Press, 482 pp.

Hu, J.L. 2001. *Spiders in Qinghai-Tibet Plateau of China*. Henan Science and Technology Publishing House, 658 pp.

Hu, J.L. & Li, A.H. 1987. The spiders collected from the fields and the forests of Xizang Autonomous Region, China. (II). *Agricultural Insects, Spiders, Plant Diseases and Weeds of Xizang*, 2: 247-353.

Jocqué, R. 2002. Genitalic polymorphism—a challenge for taxonomy. *The Journal of Arachnology*, 30(2), 298-306.

Okuma, C., Kamal, N.Q., Hirashima, Y., Alam, M.Z. & Ogata, K. 1993. *Illustrated Monograph of the Rice Field Spiders of Bangladesh.* Institute of Postgraduate Studies in Agriculture (Salna, Gazipur, Bangladesh). Japan International Cooperation Agency Project Publication, 1, 93 pp.

Roewer, C.F. 1955. *Katalog der Araneae von 1758 bis 1940, bzw. 1954. 2. Band, Abt. a (Lycosaeformia, Dionycha [excl. Salticiformia]). 2. Band, Abt. b (Salticiformia, Cribellata)*

(Synonyma-Verzeichnis, Gesamtindex). Institut royal des Sciences naturelles de Belgique, Bruxelles, 1751 pp.

Schenkel, E. 1963. Ostasiatische Spinnen aus dem Muséum d'Histoire naturelle de Paris. *Mémoires du Muséum National d'Histoire Naturelle de Paris* (A, Zool.) 25: 1-481.

Sen, S., Dhali, D.C., Saha, S. & Raychaudhuri, D. 2015. Spiders (Araneae: Arachnida) of Reserve Forests of Dooars: Gorumara National Park, Chapramari Wildlife Sanctuary and Mahananda Wildlife Sanctuary. *World Scientific News*, 20: 1-339.

Sherriffs, W.R. 1939. Hong-Kong spiders. Part V. *Hong-kong Naturalist*, 9: 135-140.

Song, D.X., Zhu, M.S. & Chen, J. 1999. *The spiders of China*. Hebei Science and Technology Publishing House, Shijiazhuang, 640 pp.

Thorell, T. 1890. Diagnoses aranearum aliquot novarum in Indo-Malesia inventarum. *Annali del Museo Civico di Storia Naturale di Genova*, 30: 132-172.

Tikader, B.K. & Biswas, B. 1981. Spider fauna of Calcutta and vicinity: Part-I. *Records of the Zoological Survey of India, Occasional Paper*, 30: 1-149.

Tikader, B.K. & Malhotra, M.S. 1980. Lycosidae (wolf-spiders). *Fauna India* (Araneae), 1(2): 248-447.

Tikader, B.K. & Mukerji, S. 1971. A new species of spider of the genus *Lycosa* (family Lycosidae) from India. *Science and Culture*, 37: 531.

Tyagi, K., Kumar, V., Kundu, S., Pakrashi, A., Prasad, P., Caleb, J.T.D. & Chandra, K. 2019. Identification of Indian spiders through DNA barcoding: cryptic species and species complex. *Scientific Reports*, 9(14033): 1-13 & Supplement.

Wang, D. & Zhang, Z.S. 2014. Two new species and a new synonym in the *Pardosa nebulosa*-group (Lycosidae: *Pardosa*) from China. *Zootaxa*, 3856(2): 227-240.

Wang, L.Y., Lu, T., Cai, D.C., Barrion, A.T., Heong, K.L., Li, S.Q. & Zhang, Z.S. 2021. Review of the wolf spiders from Hainan Island, China (Araneae: Lycosidae). *Zoological Systematics*, 46(1): 16-74.

World Spider Catalog 2021. *World Spider Catalog*. Version 22.0. Natural History Museum Bern, online at http://wsc.nmbe.ch, accessed on April 2021.

Yang, X.F. & Chai, B.Q. [=B.Q. Tsai] 1998. A study on five wolf spiders of the group *Pardosa nebulosa* from China including a new species redescribetion [sic]. *Journal of Hunan Normal University, Natural Sciences*, 26: 60-64.

Yin, C.M., Peng, X.J., Xie, L.P., Bao, Y.H. & Wang, J.F. 1997. *Lycosids in China (Arachnida: Araneae)*. Hunan Normal University Press, 317 pp.

Yin, C.M., Peng, X.J., Yan, H.M., Bao, Y.H., Xu, X., Tang, G., Zhou, Q.S. & Liu, P. 2012. *Fauna Hunan: Araneae in Hunan, China*. Hunan Science and Technology Press, Changsha, 1590 pp.

Zhao, J.Z. 1993. *Spiders in the Cotton Fields in China*. Wuhan Publishing House, Wuhan, China, 552 pp.

Serket (2021) vol. 17(4): 413-419.

First record of male *Tropizodium viridurbium* Prajapati, Murthappa, Sankaran & Sebastian, 2016 from Melghat forest (Araneae: Zodariidae) India

Atul K. Bodkhe [1] , Virendra P. Uniyal [2], Subhash S. Kamble [1], Shazia Quasin [2], Gajanan B. Santape [3], Mahesh P. Chikhale [3] & Sawan M Deshmukh [4]

[1] Spider Research Laboratory (S.R Lab) J. D. Patil Sangludkar Mahavidyalaya Daryapur District-Amravati (MS), India

[2] Wild Life Institute of India, Dehradun, Uttaranchal, India

[3] Rajshree Shahu Science Mahavidyalaya, Chandur Railway, District-Amravati (MS), India

[4] Bharatiya Mahavidyalaya, Morshi, District-Amravati (MS), India

Abstract

The spiders of family Zodariidae mimic with ants and feed on them. Presently 12 species are reported from genus *Tropizodium* Jocqué & Churchil, 2005. Present paper deals with first record of male *Tropizodium viridurbium* from Melghat forest, Maharashtra, along with the description of the female.

Keywords: Zodariidae, *Tropizodium*, First record, Nawab Nala, India.

Introduction

Zodariidae, commonly known as ant-eaters, are small to medium sized araneomorph, ecribellate, entelegyne, three clawed spiders, having six or eight eyes (Jocqué & Dippenaar-Schoeman, 2006). Jocqué & Billen (1987) hypothesized that these spiders having the insecticidal compound which release from femoral organ of spider (Pekar, 2004). Zodariidae differ from all other families by the absence of serrulae on the endites, the presence of long anterior spinnerets, and lateral implantation of tarsal claw teeth (Jocqué, 1991).

Tropizodium Jocqué & Churchill (2005) is a small genus which consists of 12 species worldwide with 5 species among those from India (World Spider Catalog, 2021). Jocqué & Churchill (2005) established this genus and described two new species: *T. peregrinum* from Northern Australia and *T. molokai* from Hawaii and transferred *Zodarium trispinosum* Suman, 1967 to *T. trispinosum* which was recorded from Hawaii.

Dankittipakul *et al.* (2012) described two new species: *Tropizodium murphyorum* from Bali, Indonesia and *T. siam* from northern Thailand, transferred *Zodariellum serraferum* Lin & Li, 2009 to *Tropizodium*, and considered *Indozodion* Ovtchinnikov, 2006 a junior synonym of *Tropizodium* and its single species became *T. inayatullahi* (Ovtchinnikov, 2006).

Prajapathi *et al.* (2016) recorded this genus for the first time from India and described two new species: *T. kalami* and *T. viridurbium*; however the second species is only known from a female. Present distribution of *Tropizodium* is Hawaii, French Polynesia (Society Is., Tuamotu), Bali (Indonesia), Northern territory of Australia, China, Pakistan, Thailand and India.

Genus *Tropizodium* is characterized by small intercheliceral triangle, extremely large AME and very small ALE, PME, and PLE. Straight embolus, epigyne with short copulatory duct. Its representatives are among the most derived members of the Zodariinae but they are very rare to collect. Present paper deals with first record of male *T. viridurbium* along with the description of its female from Melghat forest, Maharashtra.

Material and Methods

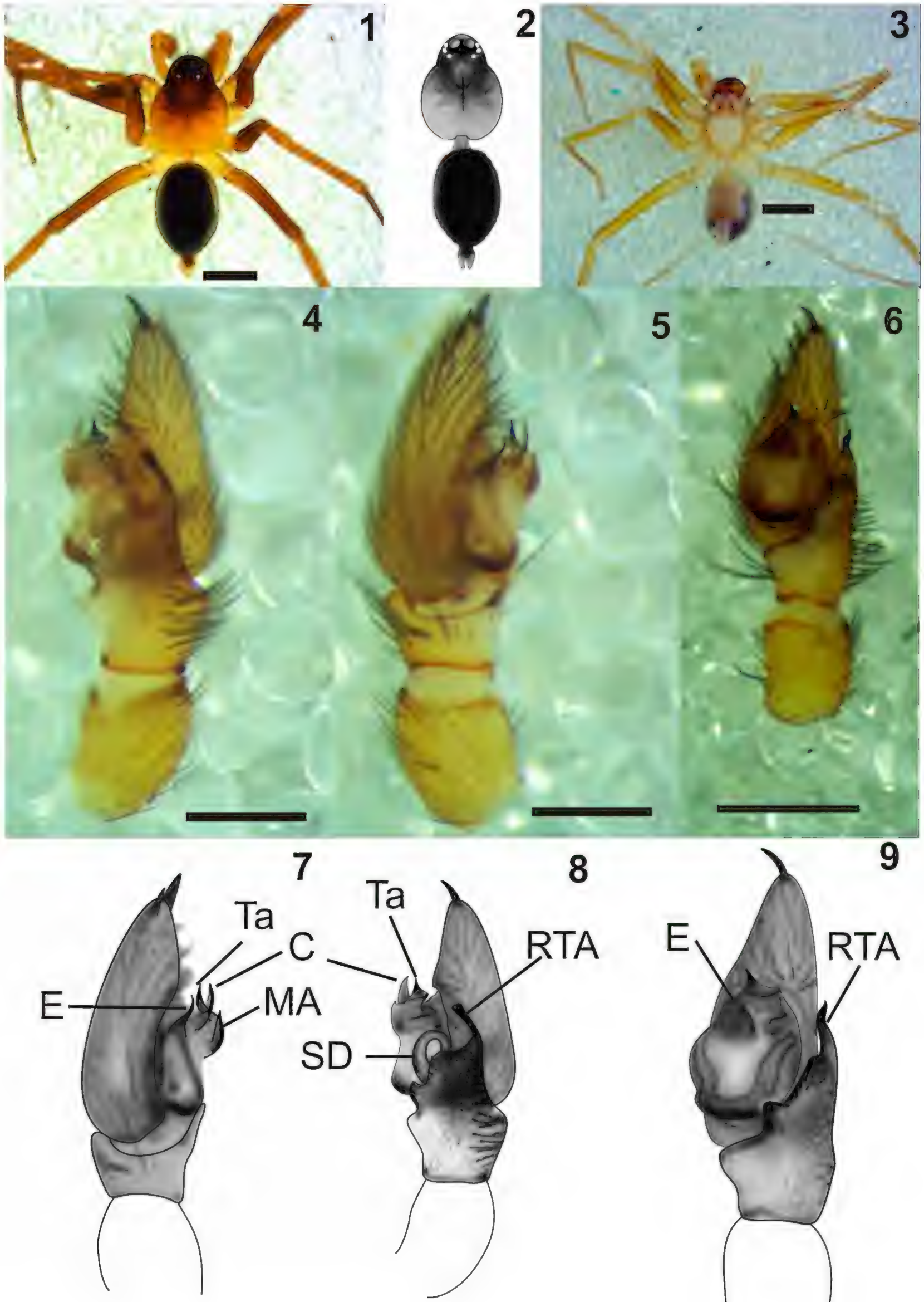
The present study is based on material collected on 13th October 2016 & 17th April, 2017. Specimens were collected by active search method and hand picking. They are preserved in 70% ethanol. Female genitalia was excised using fine surgical scalpel and cleared in 10% KOH aqueous solution. The basic identification of specimens was made by a Carl-Zeiss Stemi 2000-c Stereo-Zoom microscope mounted with Axio Cam ERc5s camera. All specimens are currently deposited in the Spider Research Laboratory (SR Lab) of J.D. Patil Sangludkar Mahavidyalaya Daryapur District Amravati, Maharashtra, India. All measurements are in millimetres.

Abbreviations in the text as follows: ALE = anterior lateral eye, AME = anterior median eye, C = conductor, d = dorsal, E = embolus, L = length, MA = median apophysis, PLE = posterior lateral eye, PME = posterior median eye, r = retrolateral, RTA = retrolateral tibial apophysis, SD = sperm duct, Ta = terminal apophysis, v = ventral, vt = ventral terminal, W = width.

Taxonomic Treatment

Material examined: 1♂ collected from Buralghat, Dharkhora Satpura Landscape (MP), India (21°24'42.9"N, 077°27'21.7"E) on 13th October 2016, collected by Subhash Kamble SR Lab J.D. Patil Sangludkar Mahavidyalaya Daryapur District Amravati, Maharashtra, India. 5♂♂, 1♀ collected from Nawab Nala, Melghat Forest, Maharashtra, India (21°23'51.5"N, 077°28'29.6"E) on 17th April 2017 collected by Atul Bodkhe SR Lab J.D. Patil Sangludkar Mahavidyalaya Daryapur District Amravati, Maharashtra, India.

Diagnosis: Morphologically matches with *T. kalami* Prajapati, Murthappa, Sankaran & Sebastian, 2016 but different in the RTA shape. Here, RTA is small and does not reach to anterior cymbium. Placement of embolus and structure of conductor and median apophysis differ in *Tropizodium viridurbium*.



Figs. 1-9. *Tropizodium viridurbium* ♂. 1-2. dorsal view. 3. ventral view. 4-9. Palp. 4, 8. prolateral view. 5, 7. retrolateral view. 6, 9. ventral view. (Scale bar: 2 mm (1 & 3), 0.2 mm (4-6)).

Distribution: Gandhinagar, Aranya Park near Palaj, Gujarat [Type locality]; Buralghat, Dharkhora Satpura Landscape, Madhya Pradesh; Nawab Nala, Melghat, Maharashtra, India.

Description:

Male: Total length 3.6 L, Cephalothorax 1.6 L, 1.3 W, Abdomen 1.9 L, 0.9 W, Sternum 0.89 L, 0.78 W, Clypeus 0.31, chelicerae 0.53 L. Eyes diameters and interdistances: AME 0.18, PME 0.07, ALE 0.09, PLE 0.08, AME-AME 0.07, PME-PME 0.26, AME-ALE 0.031, PME-PLE 0.06.

Cephalothorax pear shaped, pale yellow colour thoracic region, dark colour and narrowed cephalic region. Cephalic region highly elevated. Elevation starts from fovea and Trishul-like (trident) structure can be seen on elevation. Eyes: anterior raw straight and posterior raw recurved, AME blackish and very large, centered position. Lateral eyes located on short tubercles and closely situated, PME small, silvery and shiny. Chillum absent, hairs extended from margins of clypeus and consisting of special extension at two corners. Chelicerae cylindrical with one intercheliceral triangle and golden colour with pointed hairs. Fangs short laterigrade. Labium arrow head like with elongated middle little twisted, endites and labium are rebordered. Endites ended with scapulae. Sternum shield shaped, light colour with darker borders. Legs long and slender, having trichobothria dorsally at tarsus and metatarsus with two but tibia having three. Leg formula 4123, three tarsal claws, two large dented and single middle. Leg measurements: Table (1). Leg spination: Table (3).

Palpal cymbium at apical region has a single claw and it prolaterally has 5 setae in one row. RTA small horn like, not sharply blunted. Sperm duct runs on the margin of cymbium, twisting at one portion and ended with embolus. Median apophysis funnel like, progresses forward from tegulum. Median apophysis too short (Figs. 4-9).

Abdomen blackish with creamish border, oval, entire dorsum covered with setae, ventrum creamish, clothed by setae entirely except epigastric furrow. Spinnerets light coloured, anterior pair large and rest small (Figs. 1-3).

Table 1. Leg measurements of male *Tropizodium viridurbium.*

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	1.44	0.41	1.89	2.17	1.06	6.97
II	1.55	0.43	1.65	1.28	0.82	5.73
III	1.08	0.48	1.36	1.05	0.72	4.69
IV	1.97	0.47	1.98	2.12	1.12	7.66

Female: Total Length 4.15, Carapace 1.88 L, 1.49 W, Abdomen 2.40 L, 1.81 W, Sternum 1.10 L, 0.86 W. Eyes diameters and interdistances: ALE 0.08, AME 0.17, PLE 0.08, PME 0.08, AME-AME 0.50, PME-PME 0.29, AME-ALE 0.06, ALE-PLE 0.04, PME-PLE 0.08. Chelicerae 0.71 L; Abdomen 2.73 L, 1.84 W. Female palp: femur 0.51, patella 0.28, tibia 0.29, tarsus 0.45. All characters are the same as in male but differ in size and following characters:

Cephalothorax pear shaped, light coloured, cephalic region slightly elevated, dark. Eyes situated at tip of cephalic region, clypeus elevated. Thoracic region roughly flat and light in colour, radial furrow distinct, roughly trident (Trishul shaped) fovea present like

male on thoracic region, eye region black, AME largest, dark, situated in centre; laterals sub equal and close together. PME widely separated, smallest, oval and whitish backwardly directed. At eye region few long and curved setae. Leg measurements: Table (2). Leg spination: Table (3).

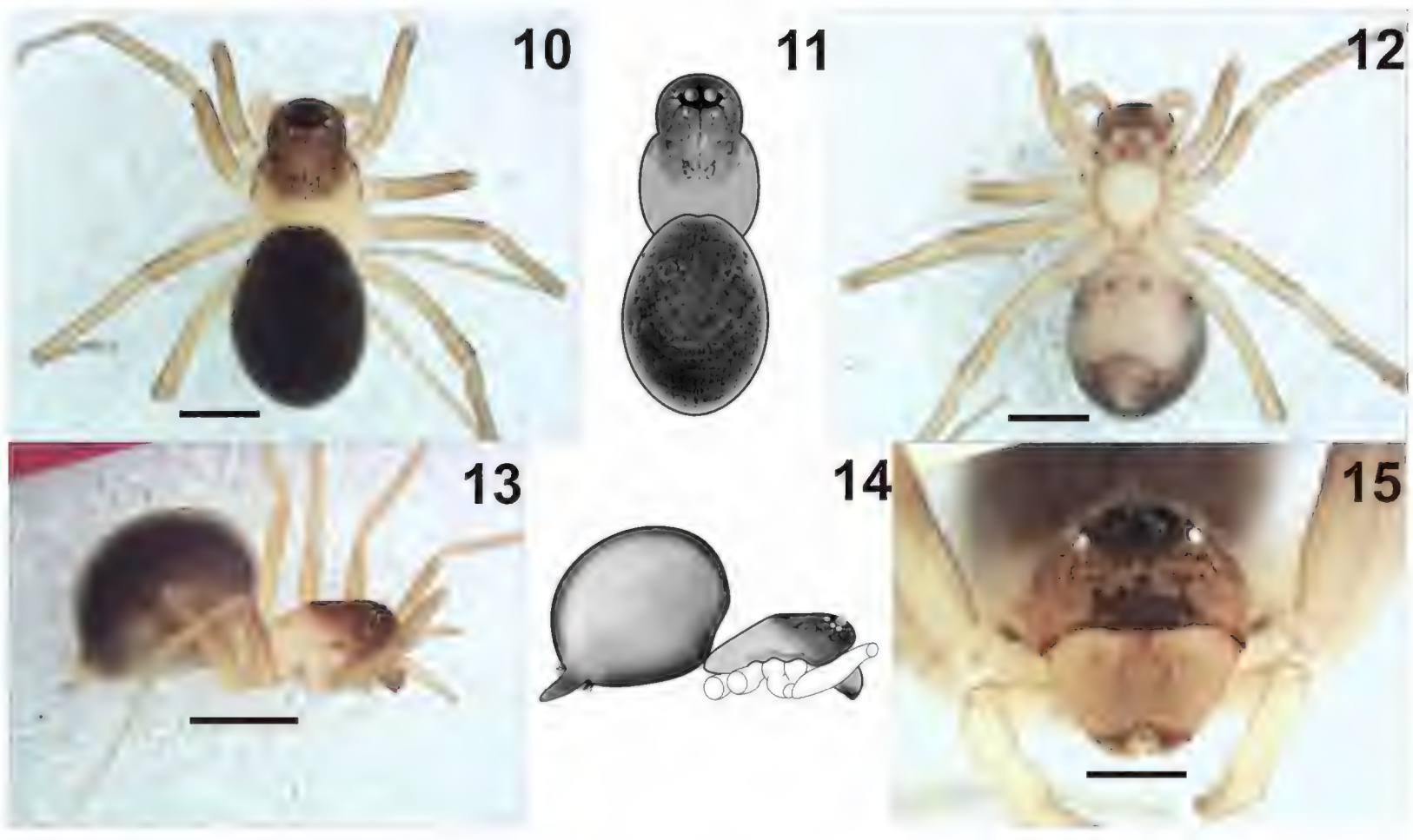
Table 2. Leg measurements of female *Tropizodium viridurbium*.

Leg	Femur	Patella	Tibia	Metatarsus	Tarsus	Total
I	1.72	0.45	1.61	2.17	1.28	7.23
II	1.45	0.42	1.28	1.86	1.09	6.10
III	1.11	0.67	1.34	1.89	0.88	5.89
IV	2.20	0.53	2.10	2.67	1.20	8.70

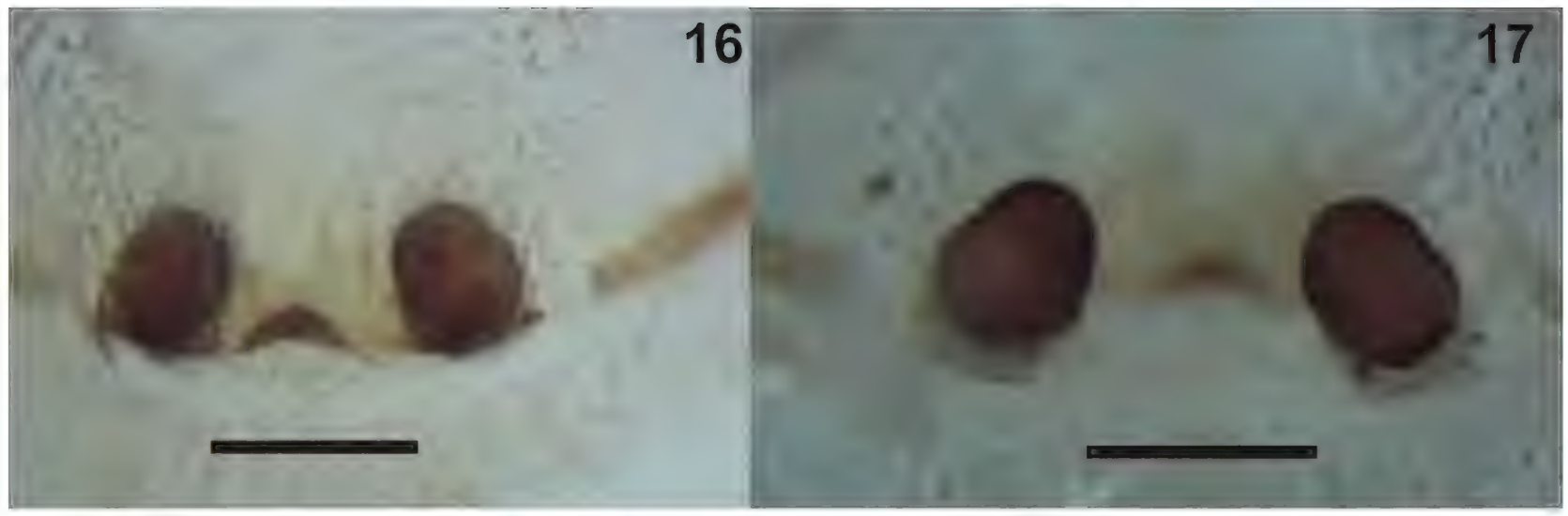
Table 3. Leg spination of male and female *Tropizodium viridurbium*.

	Male			Female		
Leg	Femur	Tibia	Metatarsus	Femur	Tibia	Metatarsus
I	d1	vt2	v1, r1, vt2	d1	vt2	v8
II	d1	vt2	v1,vt2	d1	vt2	v8
III	d1	vt2, r1	vt2	d1	vt2	v12
IV	-	vt2	v1, r1, vt2	-	vt2	v8

Abdomen oval, rotund, overhanging carapace, elevated middle and sloping towards both end, proximal tip broad while distal end tapering narrowed to tip of spinners. Clothed with white pubescence (Figs. 10-15).



Figs. 10-15. *Tropizodium viridurbium* ♀. 10-11. dorsal view. 12. ventral view. 13-14. lateral view. 15. frontal view. (Scale bar: 2 mm).



Figs. 16-19. *Tropizodium viridurbium* ♀, epigyne. 16, 18. Exterior view. 17, 19. Interior view. (Scale bar: 0.5 mm).

Epigyne in the form of three structures viz., two spermathical lobes, central curved plate. Spermathical lobes roughly oval equal sized, small coma shaped fertilization duct originated from lower tip of spermathecae. Central plate distinct dark, crescent shaped, short, not connected to spermathicae (Figs. 16-19).

Acknowledgments

Our sincere thanks to Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India (RE Division), for financial support (No.14/12/2013-RE) for financial support. We are very grateful to our Principal J. D. P. S. M, Daryapur for giving necessary facilities for research work. We are also thankful to Miss. Soniya Kale, Miss. Supriya T and Miss. Shailaja Zadkar for their field assistance that helped in the field work.

References

Dankittipakul, P., Jocqué, R. & Singtripop, T. 2012. Two new species of the spider genus *Tropizodium* Jocqué & Churchill, 2005 with notes on the femoral organ clade from southeast Asia (Araneae, Zodariidae, Zodariinae). *Zootaxa*, 3327: 62-68.

Jocqué, R. 1991. A generic revision of the spider family Zodariidae (Araneae). *Bulletin of the American Museum of Natural History*, 201: 1-160.

Jocqué, R. & Billen, J. 1987. The femoral organ of the Zodariinae (Araneae, Zodariidae). *Revue Zoologique Africaine*, 101: 165-170.

Jocqué, R. & Churchill, T.B. 2005. On the new genus *Tropizodium* (Araneae: Zodariidae), representing the femoral organ clade in Australia and the Pacific. *Zootaxa*, 944: 1-10.

Jocqué, R. & Dippenaar-Schoeman, A.S. 2006. *Spider families of the world*. Musée Royal de l'Afrique Central Tervuren, Belgium. 336 pp.

Pekár, S. 2004. Predatory behavior of two European ant-eating spiders (Araneae, Zodariidae). *Journal of Arachnology*, 32(1): 31-41.

Prajapati, D.A., Murthappa, P.S., Sankaran, P.M. & Sebastian, P.A. 2016. Two new species of the ant-eating spider genus *Tropizodium* Jocqué & Churchill, 2005 (Araneae, Zodariidae, Zodariinae) from India. *Zootaxa*, 4061(5): 575-584.

World Spider Catalog 2021. *World Spider Catalog*. Version 22.0. Natural History Museum Bern, online at http://wsc.nmbe.ch, accessed on April 2021.

Serket (2021) vol. 17(4): 420-424.

An araneological study in Ali Mountain (Kayseri, Central Anatolia, Turkey)

Osman Seyyar [*], Emre Üstün & Hakan Demir
Department of Biology, Faculty of Science and Arts, Niğde Ömer Halisdemir University, TR-51200, Niğde, Turkey
[*] Corresponding author e-mail address: osmanseyyar@hotmail.com

Abstract

Spider specimens were collected by using aspirator, sweep net and pitfall traps from Ali Mountain, located in the province of Kayseri in the Central Anatolia between 2017 and 2019. Totally 68 species belonging to 21 families were studied. All identified species are new records for the study area. All specimens were labelled and preserved as museum material in Arachnology Museum of Niğde Ömer Halisdemir University.

Keywords: Spider, Fauna, Ali Mountain, Turkey.

Introduction

In the recent years, araneological studies in Turkey were increasing. Despite this increase, there are still many regions of the country that remain insufficiently investigated. Up to now, 49368 species of 4183 genera of spiders have been described in the world (World Spider Catalog, 2021). There are only 1117 species, belonging to 52 families known from Turkey (Demir & Seyyar, 2017). The aim of this study is to determine the araneofauna of Ali Mountain (Kayseri) of Turkey.

Material and Methods

All specimens were collected from Ali Mountain in Central Anatolia (Fig. 1) by using aspirator, sweep net and pitfall traps (Fig. 2) from 12 localities in the study area during two years, between 2017 and 2019. Samples were made from every side of the mountain. The identification was made by means of a SZX61 Olympus stereomicroscope.

Museum material was used for the species identification. The specimens were labelled and preserved as museum material in Arachnology Museum of Niğde Ömer Halisdemir University (NOHUAM).

Fig. 1. General view of Ali Mountain (Kayseri Province) and collecting localities.

Locality list:
1. Ali Mountain West 1 (38°39'42.45"N, 35°32'15.31"E), 1450 m, a) 15.V.2017; b) 16.VII.2017; c) 02.IX.2017; d) 10.V.2018; e) 14.VII.2018; f) 01.IX.2018.
2. Ali Mountain North 1 (38°40'19.39"N, 35°33'4.57"E), 1376 m, a) 15.V.2017; b) 16.VII.2017; c) 02.IX.2017; d) 10.V.2018; e) 14.VII.2018; f) 01.IX.2018.
3. Ali Mountain East 1 (38°39'46.19"N, 35°33'49.30"E), 1383 m, a) 16.V.2017; b) 17.VII.2017; c) 03.IX.2017; d) 11.V.2018; e) 15.VII.2018; f) 02.IX.2018.
4. Ali Mountain South 1 (38°39'16.53"N, 35°33'10.32"E), 1575 m, a) 16.V.2017; b) 17.VII.2017; c) 03.IX.2017; d) 11.V.2018; e) 15.VII.2018; f) 02.IX.2018.
5. Ali Mountain West 2 (38°39'48.46"N, 35°32'41.77"E), 1690 m, a) 15.V.2017; b) 16.VII.2017; c) 02.IX.2017; d) 10.V.2018; e) 14.VII.2018; f) 01.IX.2018.
6. Ali Mountain North 2 (38°40'4.13"N, 35°33'12.88"E), 1514 m, a) 15.V.2017; b) 16.VII.2017; c) 02.IX.2017; d) 10.V.2018; e) 14.VII.2018; f) 01.IX.2018.
7. Ali Mountain East 2 (38°39'43.94"N, 35°33'33.68"E), 1568 m, a) 16.V.2017; b) 17.VII.2017; c) 03.IX.2017; d) 11.V.2018; e) 15.VII.2018; f) 02.IX.2018.
8. Ali Mountain South 2 (38°39'29.30"N, 35°33'15.43"E), 1690 m, a) 16.V.2017; b) 17.VII.2017; c) 03.IX.2017; d) 11.V.2018; e) 15.VII.2018; f) 02.IX.2018.
9. Ali Mountain West 3 (38°39'47.36"N, 35°32'58.25"E), 1777 m, a) 15.V.2017; b) 16.VII.2017; c) 02.IX.2017; d) 10.V.2018; e) 14.VII.2018; f) 01.IX.2018.
10. Ali Mountain North 3 (38°39'51.31"N, 35°33'11.59"E), 1786 m, a) 15.V.2017; b) 16.VII.2017; c) 02.IX.2017; d) 10.V.2018; e) 14.VII.2018; f) 01.IX.2018.
11. Ali Mountain East 3 (38°39'46.41"N, 35°33'20.87"E), 1759 m, a) 16.V.2017; b) 17.VII.2017; c) 03.IX.2017; d) 11.V.2018; e) 15.VII.2018; f) 02.IX.2018.
12. Ali Mountain South 3 (38°39'39.37"N, 35°33'10.96"E), 1844 m, a) 16.V.2017; b) 17.VII.2017; c) 03.IX.2017; d) 11.V.2018; e) 15.VII.2018; f) 02.IX.2018.

Results and Discussion

A total of 68 spider species in 21 families were determined from the study area (Table 1). Most species rich families were Gnaphosidae (18), Salticidae (9), and Thomisidae (6). According to the result of this study, the spider diversity in study area contains nearly 7.5% at the species level of 39 families of Turkish spiders (Fig. 3).

Fig. 2. Photos of fieldworks in the study area.

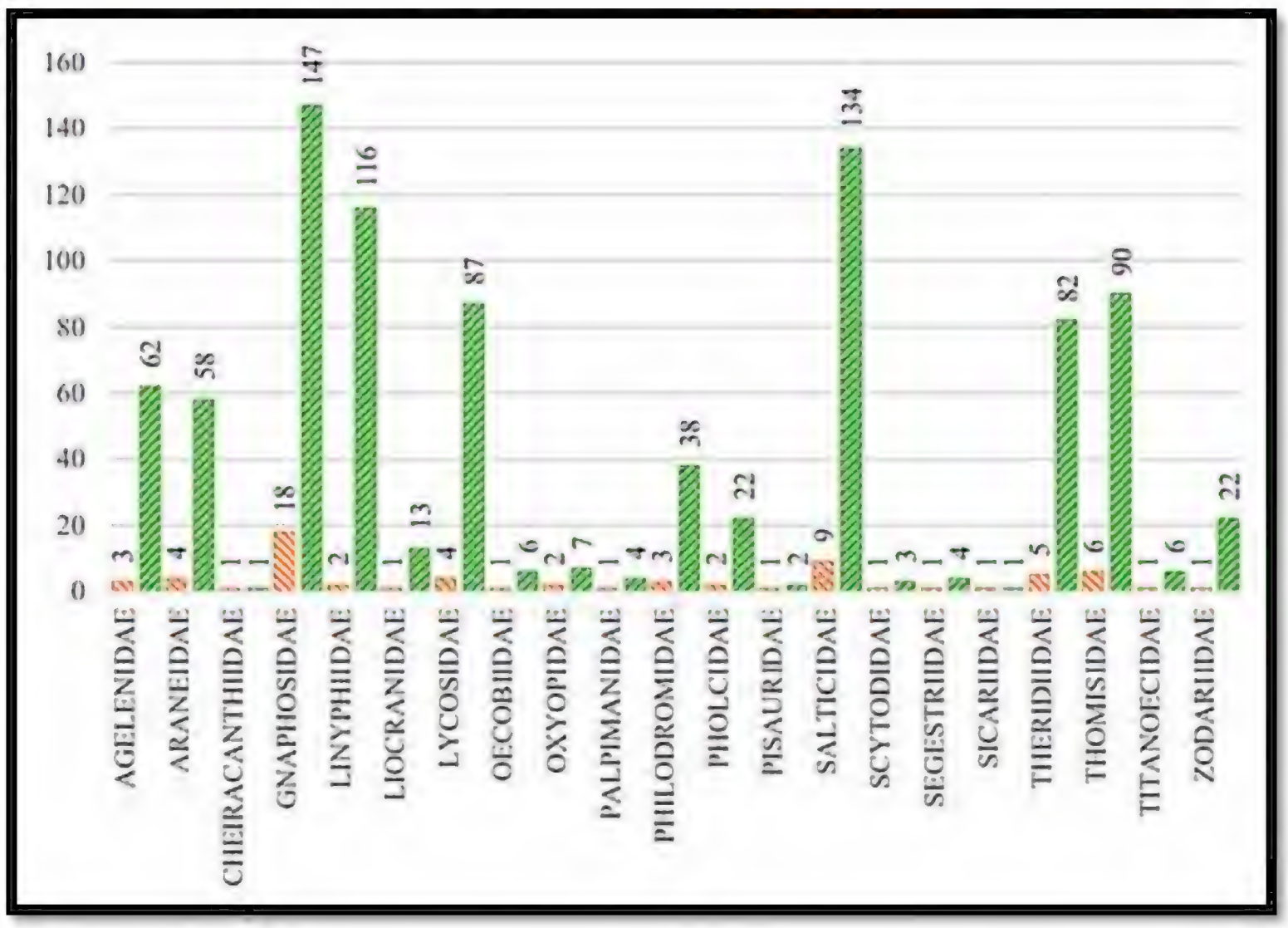


Fig. 3. Comparison of species numbers of 21 spider families in Turkey (green) and the study area, Ali Mountain (Kayseri Province).

Table 1. The spider list from the study area, Ali Mountain (Kayseri Province).

Family AGELENIDAE			
1	*Agelena labyrinthica* (Clerck, 1757)	3	*Textrix denticulata* (Olivier, 1789)
2	*Tegenaria argaeica* Nosek, 1905		
Family ARANEIDAE			
1	*Aculepeira ceropegia* (Walckenaer, 1802)	3	*Larinioides cornutus* (Clerck, 1757)
2	*Argiope lobata* (Pallas, 1772)	4	*Neoscona adianta* (Walckenaer, 1802)
Family CHEIRACANTHIIDAE			
1	*Cheiracanthium mildei* L. Koch, 1864		
Family GNAPHOSIDAE			
1	*Anagraphis pallens* Simon, 1893		
2	*Callilepis nocturna* (Linnaeus, 1758)		
3	*Civizelotes caucasius* (L. Koch, 1866)		
4	*Drassodes lacertosus* (O. Pickard-Cambridge, 1872)		
5	*Drassodes lapidosus* (Walckenaer, 1802)		
6	*Gnaphosa dolosa* Herman, 1879		
7	*Gnaphosa opaca* Herman, 1879		
8	*Haplodrassus invalidus* (O. Pickard-Cambridge, 1872)		
9	*Haplodrassus signifer* (C.L. Koch, 1839)		
10	*Marinarozelotes malkini* (Platnick & Murphy, 1984)		
11	*Micaria coarctata* (Lucas, 1846)		
12	*Nomisia aussereri* (L. Koch, 1872)		
13	*Nomisia conigera* (Spassky, 1941)		
14	*Nomisia exornata* (C.L. Koch, 1839)		
15	*Nomisia ripariensis* (O. Pickard-Cambridge, 1872)		
16	*Pterotricha lentiginosa* (C.L. Koch, 1837)		
17	*Zelotes longipes* (L. Koch, 1866)		
18	*Zelotes subterraneus* (C.L. Koch, 1833)		
Family LINYPHIIDAE			
1	*Frontinellina frutetorum* (C.L. Koch, 1835)	2	*Lepthyphantes leprosus* (Ohlert, 1865)
Family LIOCRANIDAE			
1	*Mesiotelus scopensis* Drensky, 1935		
Family LYCOSIDAE			
1	*Alopecosa pulverulenta* (Clerck, 1757)	3	*Pardosa agrestis* (Westring, 1861)
2	*Hogna radiata* (Latreille, 1817)	4	*Pardosa proxima* (C.L. Koch, 1847)
Family OECOBIIDAE			
1	*Uroctea durandi* (Latreille, 1809)		
Family OXYOPIDAE			
1	*Oxyopes heterophthalmus* (Latreille, 1804)	2	*Oxyopes lineatus* Latreille, 1806
Family PALPIMANIDAE			
1	*Palpimanus gibbulus* Dufour, 1820		
Family PHILODROMIDAE			
1	*Philodromus cespitum* (Walckenaer, 1802)		
2	*Philodromus margaritatus* (Clerck, 1757)		
3	*Thanatus oblongiusculus* (Lucas, 1846)		

Family PHOLCIDAE			
1	*Holocnemus pluchei* (Scopoli, 1763)	2	*Pholcus phalangioides* (Fuesslin, 1775)
Family PISAURIDAE			
1	*Pisaura mirabilis* (Clerck, 1757)		
Family SALTICIDAE			
1	*Ballus chalybeius* (Walckenaer, 1802)	6	*Phlegra fasciata* (Hahn, 1826)
2	*Cyrba algerina* (Lucas, 1846)	7	*Plexippus paykulli* (Audouin, 1825)
3	*Evarcha falcata* (Clerck, 1757)	8	*Pseudeuophrys obsoleta* (Simon, 1868)
4	*Heliophanus edentulus* Simon, 1871	9	*Talavera aequipes* (O. Pickard-Cambridge, 1871)
5	*Philaeus chrysops* (Poda, 1761)		
Family SCYTODIDAE			
1	*Scytodes thoracica* (Latreille, 1802)		
Family SEGESTRIIDAE			
1	*Segestria bavarica* C.L. Koch, 1843		
Family SICARIIDAE			
1	*Loxosceles rufescens* (Dufour, 1820)		
Family THERIDIIDAE			
1	*Enoplognatha mandibularis* (Lucas, 1846)	4	*Steatoda paykulliana* (Walckenaer, 1806)
2	*Episinus truncatus* Latreille, 1809	5	*Theridion melanurum* Hahn, 1831
3	*Euryopis laeta* (Westring 1861)		
Family THOMISIDAE			
1	*Bassaniodes caperatus* (Simon, 1875)		
2	*Bassaniodes pseudorectilineus* (Wunderlich, 1995)		
3	*Heriaeus graminicola* (Doleschall, 1852)		
4	*Synema globosum* (Fabricius, 1775)		
5	*Thomisus onustus* Walckenaer, 1805		
6	*Xysticus edax* (O. Pickard-Cambridge, 1872)		
Family TITANOECIDAE			
1	*Nurscia albomaculata* (Lucas 1846)		
Family ZODARIIDAE			
1	*Zodarion thoni* Nosek, 1905		

References

Demir, H. & Seyyar, O. 2017. Annotated checklist of the spiders of Turkey. *Munis Entomology & Zoology*, 12(2): 433-469.

World Spider Catalog 2021. *World Spider Catalog*. Version 22.0. Natural History Museum Bern, online at http://wsc.nmbe.ch, accessed on April 2021.

Serket (2021) vol. 17(4): 425-428.

Notes on *Callilepis cretica* (Araneae: Gnaphosidae) and a new locality in Turkey

Osman Seyyar
Department of Biology, Faculty of Science and Arts, Niğde Ömer Halisdemir University, TR-51200, Niğde, Turkey
E-mail address: osmanseyyar@hotmail.com

Abstract

Callilepis cretica was originally described by Roewer (1928) from Crete island as *Minosia cretica*. It was recorded first time from Anatolia by Seyyar *et al.* (2006). In this study, we add new locality to its distribution in Anatolia. Its general habitus and genitalia are illustrated.

Keywords: Spiders, *Callilepis cretica*, new locality record, Anatolia, Turkey.

Introduction

Ground spiders is now the largest spider family in Turkey. The known gnaphosid fauna of Turkey includes 150 species and 33 genera (Topçu *et al.*, 2005; Demir & Seyyar, 2017; Seyyar *et al.*, 2019a, b, c; Seyyar & Demir, 2020a, b). *Callilepis cretica* was originally described by Roewer (1928) from Crete island as *Minosia cretica*. This species was known from three different regions of Turkey: Central Anatolia Region (CAR) (Seyyar *et al.*, 2006; Demir *et al.*, 2015), Aegean Region (Seyyar & Demir, 2019), and Mediterranean Region (Demir & Seyyar, 2018). We could find it in two new localities in Black Sea Region from Turkey. The aim of this paper is to present new locality records of the gnaphosid spider *Callilepis cretica* (Roewer, 1928) from Turkey. The new recording of this species widens its distribution in Turkey (Fig 1).

Material and Methods

In this study, both male and female specimens were collected from Gümüşhane and Tokat Provinces (Kelkit Valley) in Anatolia. Examined specimens were preserved in 70% ethanol and deposited in the NOHUAM (Arachnology Museum of Niğde Ömer Halisdemir University). For the identification, Seyyar *et al.* (2006) was consulted. The identification was made by means of a SZX61 Olympus stereomicroscope.

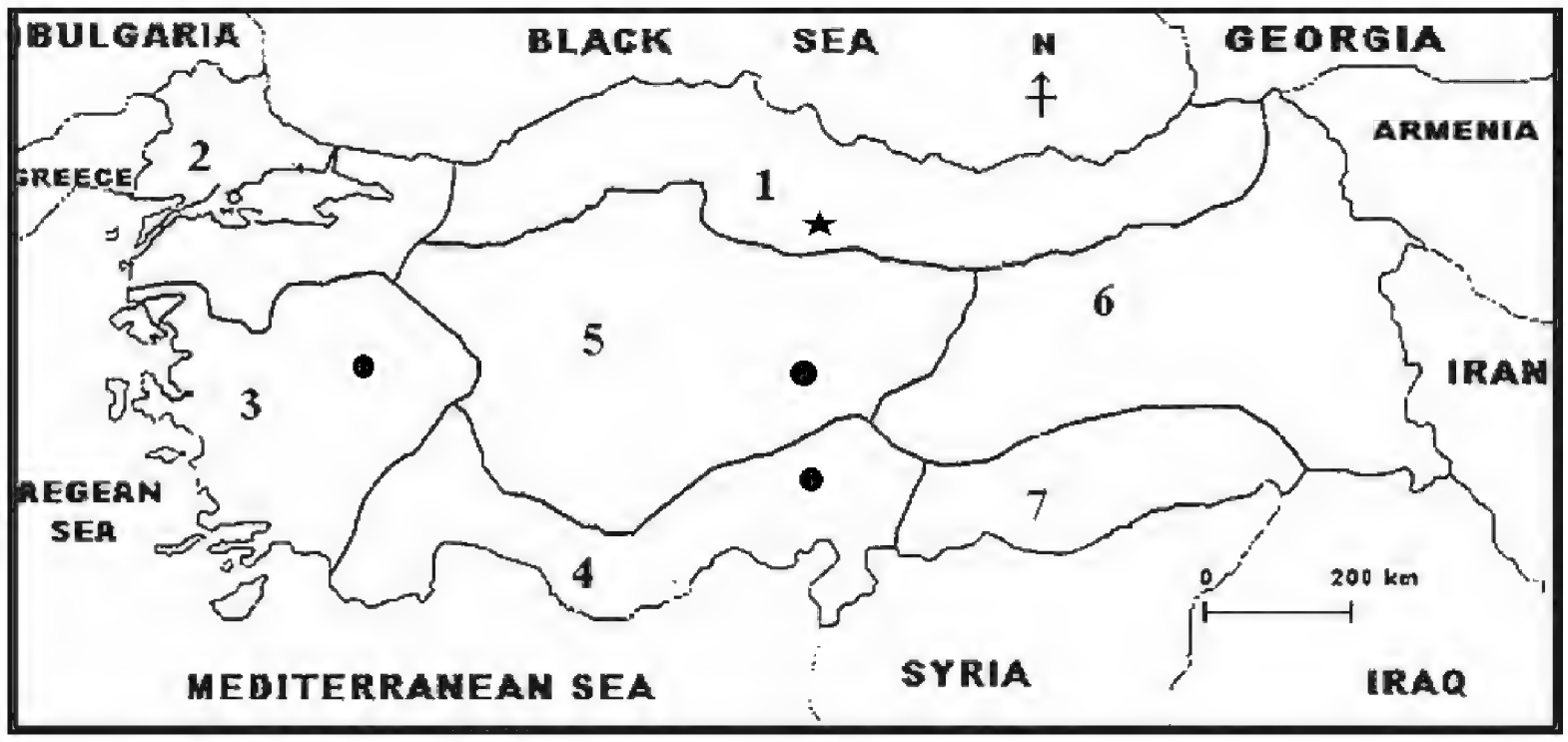


Fig. 1. Localities of *Callilepis cretica* (Roewer, 1928). Geographical regions of Turkey: 1-Black Sea Region, 2-Marmara region, 3-Aegean region, 4-Mediterranean region, 5-Central Anatolia Region, 6-East Anatolia Region, 7-Southeastern Anatolia Region. Old localities (●) and New locality (★) in Gümüşhane and Tokat Provinces.

Results

Callilepis cretica (Roewer, 1928) Figs. 2-4.

Fig. 2. *Callilepis cretica* (Roewer, 1928) ♂♀. Habitus, dorsal view.

Taxonomic references [after World Spider Catalog (2021)]
Minosia cretica Roewer, 1928b: 113, pl. 1, f. 23-24 (D♂♀).
Callilepis wiehlei Bristowe, 1935: 780, f. 7-12 (D♂♀).
Callilepis cretica Wunderlich, 1977a: 292, f. 8-9 (T♂♀ from *Crosbyellum=Minosia*, S).
Callilepis cretica Chatzaki, Thaler & Mylonas, 2002a: 575, f. 20-23 (♂♀).
Callilepis cretica Seyyar, Topçu & Demir, 2006: 118, f. 1-3 (♂♀).

Collected specimens: Black Sea Region: Gümüşhane Province: 2♂♂, 3♀♀, Şiran district, Seydibaba village, around the Tomara fall (40°06'20.95"N, 36°02'42.28"E), 1540 m, 30.V.2019, Leg. Hakan Demir & Osman Seyyar. Tokat Province: 2♂♂,1♀, Niksar District, Arpaören village (40°30'10.62"N, 36°59'37.36"E), 512 m, 30.V.2019, Leg. Osman Seyyar & Hakan Demir.

Fig. 3. *Callilepis cretica* (Roewer, 1928) ♀, epigyne.

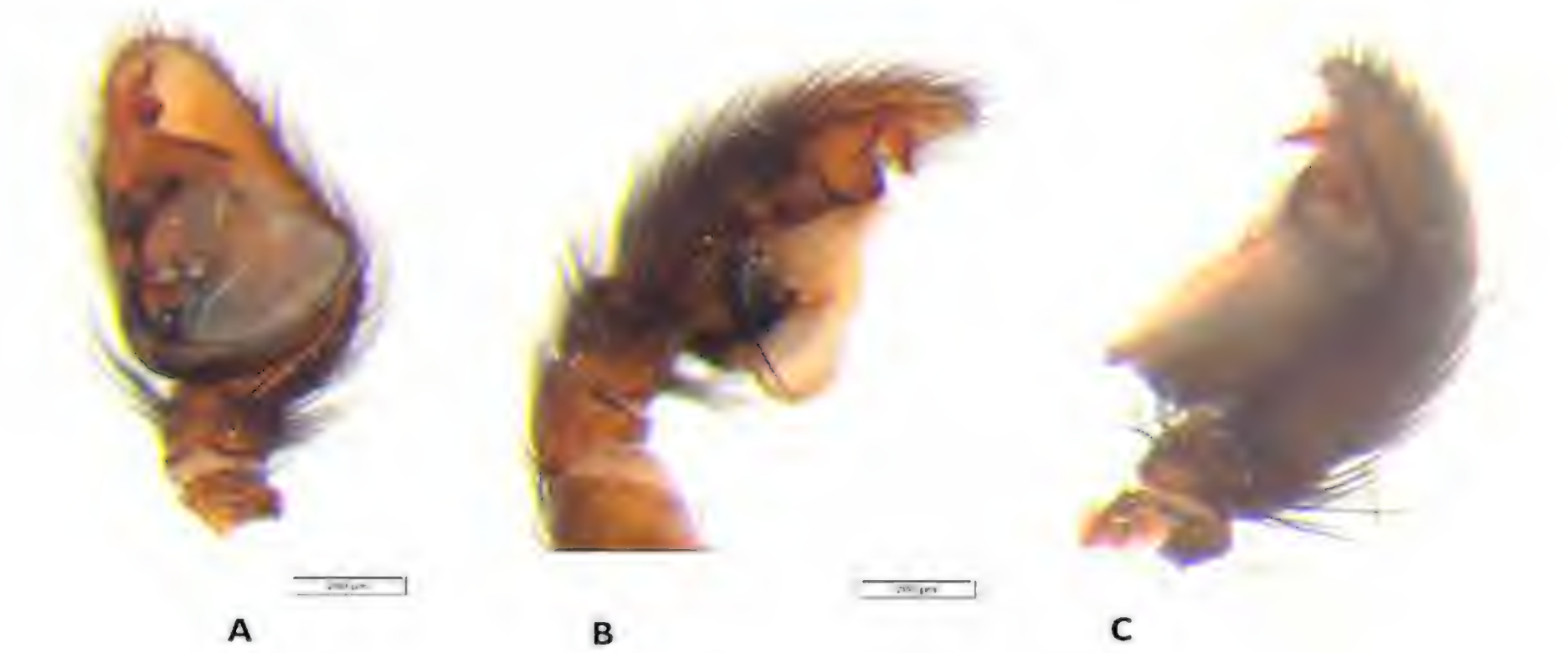


Fig. 4. *Callilepis cretica* (Roewer, 1928) ♂, palp. A. ventral view. B. retrolateral view. C. prolateral view.

Acknowledgment

The authors acknowledge the Scientific and Technological Research Council of Turkey (TÜBİTAK) (Project no: 118Z361).

References

Demir, H. & Seyyar, O. 2017. Annotated checklist of the spiders of Turkey. *Munis Entomology & Zoology*, 12(2): 433-469.

Demir, H. & Seyyar, O. 2018. Arachnofauna of Eastern Mediterranean region of Turkey (Arthropoda: Chelicerata: Arachnida). *Serket*, 16(2): 69-73.

Demir, H., Seyyar, O., Türker, H., Koçyiğit, H.O. & Öner, H. 2015. The spider fauna of Melendiz Mountains, Niğde, Turkey. *Serket*, 14(3): 146-166.

Roewer, C.F. 1928. Araneae. In: Zoologische Streifzüge in Attika, Morea, und besonders auf der Insel Kreta, II. Abhandlungen des Naturwissenschaftlichen Vereins zu Bremen 27: 92-123.

Seyyar, O. & Demir, H. 2019. The spider fauna of the inner part of Western Anatolia. *Serket*, 16(4): 191-199.

Seyyar, O. & Demir, H. 2020a. *Berlandina nabozhenkoi* Ponomarev & Tsvetkov, 2006 (Araneae: Gnaphosidae) is a new spider record from Turkey. *Arthropods*, 9(3): 92-97.

Seyyar, O. & Demir, H. 2020b. *Zelotes fulvaster* (Simon, 1878) (Araneae: Gnaphosidae) is a new spider record from Turkey. *Serket*, 17(2): 133-135.

Seyyar, O., Demir, H. & Ok, D. 2019a. *Marjanus* Chatzaki, 2018 and *Marjanus platnicki* (Zhang, Song & Zhu, 2001) (Araneae: Gnaphosidae) are new records for Turkish Spider Fauna. *Serket*, 16(4): 200-202.

Seyyar, O., Demir, H. & Türkeş, T. 2019b. *Kishidaia conspicua* (L. Koch, 1866) (Araneae: Gnaphosidae) is a new record for Turkish spider fauna. *Serket*, 17(1): 45-47.

Seyyar, O., Kılınç, H. & Demir, H. 2019c. *Lasophorus* Chatzaki, 2018 and *Lasophorus zografae* Chatzaki, 2018 (Araneae: Gnaphosidae) are new records for Turkish spider fauna. *Serket*, 17(1): 42-44.

Seyyar, O., Topçu, A. & Demir, H. 2006. New records of ground spiders (Araneae: Gnaphosidae) from Anatolia. *Zoology in the Middle East*, 38: 118-120.

Topçu, A., Demir, H. & Seyyar, O. 2005. A Checklist of the spiders of Turkey. *Serket*, 9(4): 109-140.

World Spider Catalog 2021. *World Spider Catalog*. Version 22.0. Natural History Museum Bern, online at http://wsc.nmbe.ch, accessed on April 2021.

Serket (2021) vol. 17(4): 429-437.

Regional diversity of spiders in the selected sacred groves of northern Kerala, India

Njarekkattil Vasu Sumesh & Ambalaparambil Vasu Sudhikumar *
Centre for Animal Taxonomy and Ecology (CATE), Department of Zoology, Christ College (Autonomous), Irinjalakuda, Kerala-680125, India
* Corresponding author e-mail address: spidersudhi@gmail.com

Abstract

Sacred groves of Northern Kerala operate as an ideal centre for biodiversity conservation. Several threatened animals and plants are still well conserved in the sacred groves. Present study intends to discover the regional diversity of spiders from the selected sacred groves of Kasargod and Kannur districts. Fifteen sacred groves from Kasargod and Kannur districts were selected for this study. Spider sampling was carried out from February 2016 till January 2018. The sampling methods such as line transect method, handpicking in ground and strata, and beating were used to catch specimens. The caught specimens were preserved and identified to species and genus level using available literature. This study found 11308 individuals of 257 species come under 136 genera. Abundance of spiders in the sacred groves of Kasargod district was 2904 individuals with 109 species and 8404 individuals with 220 species collected from Kannur district. The study revealed that regional wide diversity of spiders was greater in the sacred groves of Kasargod and Kannur.

Keywords: Araneae, Abundance, Diversity, Kerala, Sacred sites, India.

Introduction

The correct estimation of local and regional species richness has been considered critical for determining the shape of the relationship between these two factors (Srivastava, 1999). The ecological interpretation of diversity is not straight forward. It might be expected that diversity should increase with habitat heterogeneity. In fact, more structurally complex habitat harbour more spider species per plot, probably due to more

niches being available. The probability of species interactions is higher and the interpretation of patterns more easily related to processes operating at the local scale, such as vegetation heterogeneity and diversity (Collins *et al.*, 2002). Previous studies suggesting that species assemblages are random samples drawn from a pool of potential colonists, and also that spider communities may be largely structured by interspecific competition or local features of the habitat (Wise, 1993). Spider assemblages, in a particular small patch, probably correspond to a collection of individuals of the species present, under the constraints of habitat structure and limited niche space. Habitat management may also have intense effects on local spider assemblages, since local spider richness seems to be related to well-developed and complex vegetation. It is also important to consider the potential utility of measures of species richness in habitat management and conservation-management of sacred groves. If saturation occurs at the local scale, then diversity could be of limited value in identifying levels of mean species richness at the local scale. An investment in standardized sampling within regions, to obtain measures of diversity, would greatly enhance the understanding of processes operating at local and regional scales (Borges & Brown, 2004).

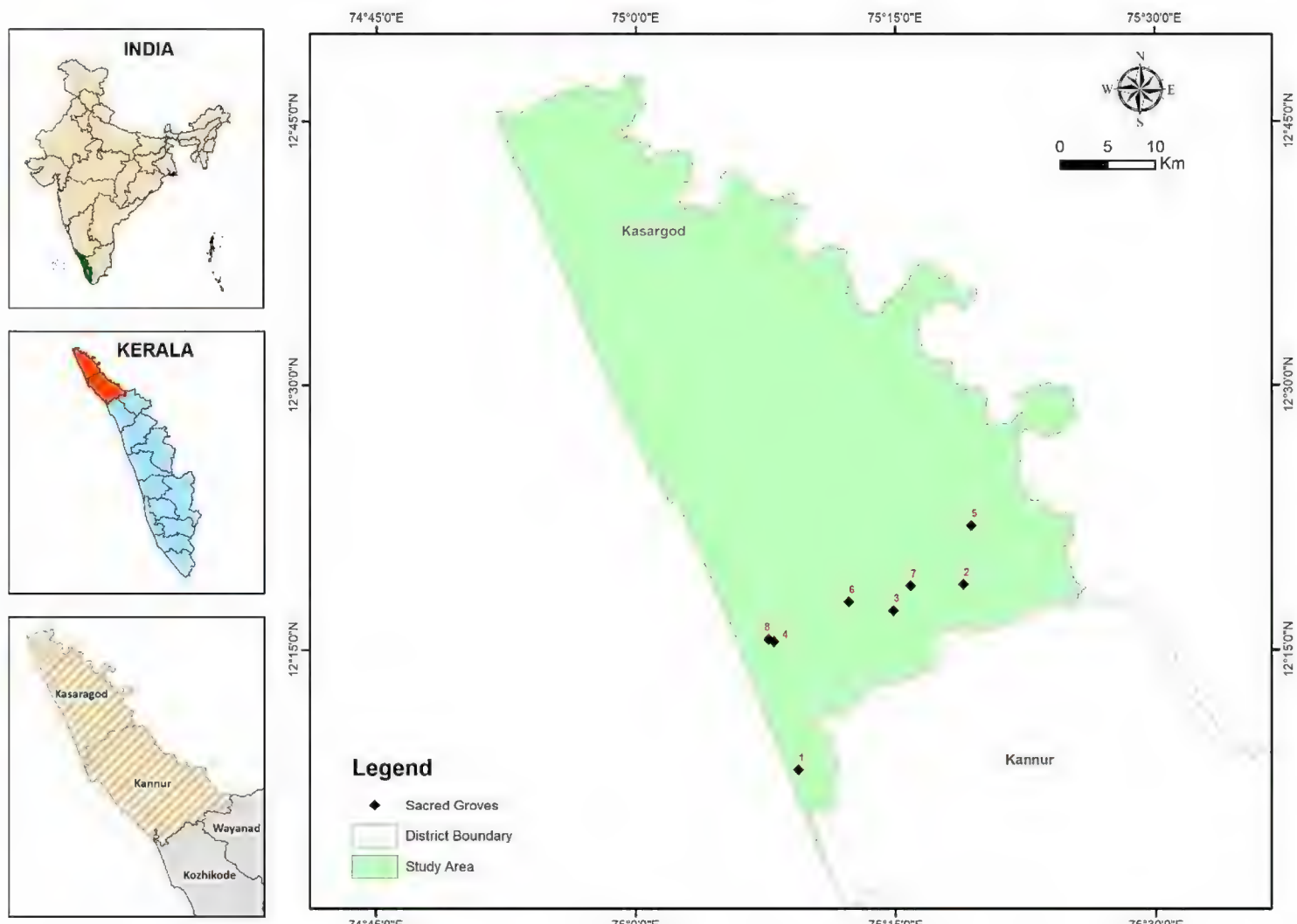


Fig. 1. Map showing the study area of Kasargod district. (1) Edayilekadu Kavu, (2) Kammadom Kavu, (3) Koyithatta Sree Dharmasastha Kavu, (4) Mannam Purathu Kavu, (5) Sree Malliyodan Kavu, (6) Payyamkulam Kavu, (7) Periyanganam Sree Dharmasastha Kavu, and (8) Puthiya Parambathu Kavu.

India is exceptionally rich in sacred groves with around 13,720 sacred groves spread across 19 states (Kapoor, 2006). The state of Kerala harbours 1500 to 2000 sacred groves, the extent of which varies from 0.004 ha to >20 ha. Sacred groves are supposed to be relics of ancient vegetation and remnants of larger forest tracts. Documenting and understanding spider assemblages in tropical ecosystems like sacred groves in the present context of rapid loss is an important task (Chandran *et al.*, 1998). Sacred groves play an important role in ensuring smooth ecosystem services such as clean environment that is, air, soil, and water conservation, flora and fauna conservation, temperature control and

conservation of traditional knowledge. Microclimatic features, soil cover, litter cover, water resources, highly diverse flora of these areas support varied array of fauna. So that they are of central importance as far as ecological conservation and policy regarding conservation and management of forest at state and national levels are concerned (Kapoor, 2006). The aim of the present study is to provide data on the regional diversity of spiders in sacred groves of Kasargod and Kannur districts of Kerala, India.

Table 1. Details of sites covered for regional diversity in sacred groves of Kasargod district.

Sl. No	Name of sacred groves	Location	Co-ordinates	Area of sacred grove (ha)
1	EDAYILEKADU KAVU	Thrikkarippoor	12°08'10.72"N 75°09'23.88"E	6.40
2	KAMMADOM KAVU	West elery	12°18'41.0"N 75°18'55.8"E	24.00
3	KOYITHATTA SREE DHARMA SASTHA KAVU	Koyithatta	12°17'11.4"N 75°14'53.88"E	3.00
4	MANNAM PURATHU KAVU	Neeleswaram	12°15'27.6"N 75°07'59.4"E	2.83
5	SREE MALLIYODAN KAVU	Konnakkad	12°22'1.24"N 75°19'22.8"E	3.00
6	PAYYAMKULAM KAVU	Kinaur, Karinthalam	12°17'41.7"N 75°12'18.96"E	5.00
7	PERIYANGANAM SREE DHARMA SASTHA KAVU	Periyanganm	12°18'36.0"N 75°15'52.56"E	2.00
8	PUTHIYA PARAMBATHU KAVU	Puthukky, Neeleswaram	12°15'34.56"N 75°07'41.16"E	3.00

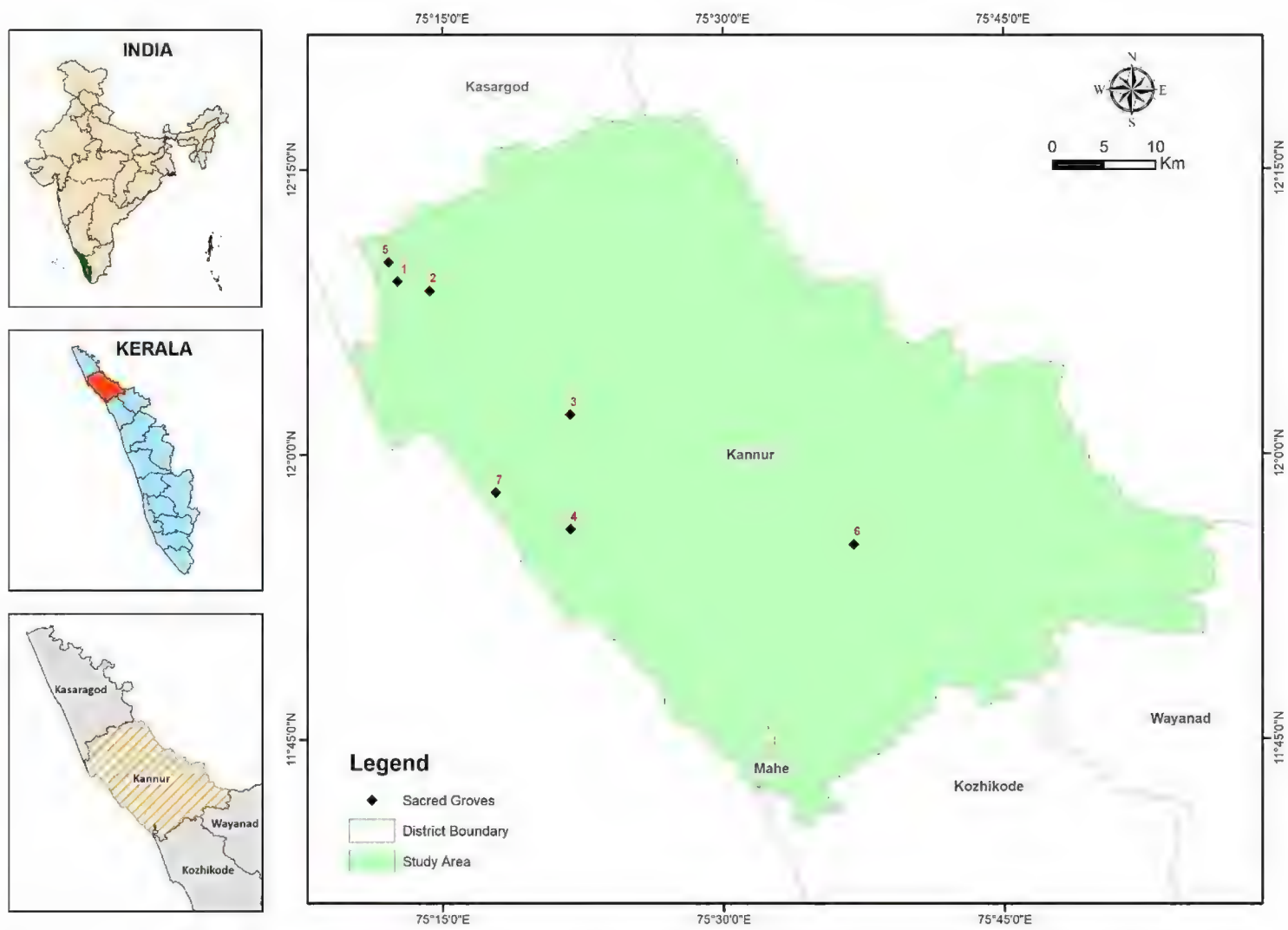


Fig. 2. Map showing the study area of Kannur district. (1) Chama Kavu, (2) Konganichal Kavu, (3) Madayi Kavu, (4) Neeliaar Kottam, (5) Palathara Kunji Kavu, (6) Poongottu Kavu, and (7) Thazhe Kavu.

Table 2. Details of sites covered for regional diversity in sacred groves of Kannur district.

Sl. No	Name of sacred groves	Location	Co-ordinates	Area of sacred grove (ha)
1	CHAMA KAVU	Vellur, Payyannur	12°09'07.03"N 75°12'35.5"E	3.640
2	KONGANICHAL KAVU	Thulluvadakkam, Alappadambu	12°08'36.41"N 75°14'18.76"E	3.320
3	MADAYI KAVU	Eripuram, madayi	12°02'05.5"N 75°21'50.0"E	6.06
4	NEELIAAR KOTTAM	Morazha, Anthoor	11°56'03.8"N 75°21'50.0"E	8.7
5	PALATHARA KUNJI KAVU	Karivellur	12°10'07.0"N 75°12'07.9"E	1.00
6	POONGOTTU KAVU	Mattannur, Poongottu	11°55'14.7"N 75°36'58.9"E	14.60
7	THAZHE KAVU	Thekkumbadam, Mattul	11°57'59.3"N 75°17'50.9"E	7.52

Material and Methods

The study areas were located in Kasargod and Kannur districts of northern Kerala. Kasargod district is one of the 14 districts in the southern Indian state of Kerala; it is located in 12°30'0"N, 075°0'0"E with an area of 1,992 km^2. The following 15 sacred groves were selected for the study according to the area and habitat type: (1) Edayilekadu Kavu, (2) Kammadom Kavu, (3) Koyithatta Sree Dharmasastha Kavu, (4) Mannam Purathu Kavu, (5) Sree Malliyodan Kavu, (6) Payyamkulam Kavu, (7) Periyanganam Sree Dharmasastha Kavu, and (8) Puthiya Parambathu Kavu are the sacred groves coming under Kasargod district (Fig. 1 & Table 1).

Kannur is one of the 14 districts along the west coast in the state of Kerala; it is located in 11°52'8.04"N, 075°21'19.66"E with an area of 2,966 km^2. The sacred groves coming under Kannur district are: (1) Chama Kavu, (2) Konganichal Kavu, (3) Madayi Kavu, (4) Neeliaar Kottam, (5) Palathara Kunji Kavu, (6) Poongottu Kavu, and (7) Thazhe Kavu (Fig. 2 & Table 2).

The general floristic composition and physiognomy of vegetation of the sacred grove are typically like the low-level evergreen forest. Floristic variations have occurred in many sacred groves exposed to human and animal interferences and climatic and edaphic changes. Generally, vegetation of the study area is divided into evergreen, semi-evergreen, freshwater Myristica swamp, moist deciduous, and mangroves (Sumesh & Sudhikumar, 2020).

The meteorological data of the study area during the study period were as follows: average annual rainfall was 779.94 mm in 2016-2017 and 970.51 in 2017-2018. May and October were the wet months while November to April is relatively dry. Relative humidity was always greater than 75%. Range of the temperature was between 18.43°C and 32.99°C. Different parameters like rainfall data, temperature, relative humidity and location details were recorded using various methods. Sampling area sites were recorded by using global positioning system (GPSmap76CSx). Temperature and relative humidity were recorded by using hygrometer (MextechM288CTHW digital thermo hygrometer with indoor/outdoor temperature). Rainfall data sets for the representative area over the study region was derived from the high-resolution gridded rainfall data sets of India Meteorological Department (IMD- Pai *et al.*, 2014).

Spider sampling was carried out from February 2016 till January 2018. The study period was divided into pre-monsoon, monsoon, and post-monsoon seasons and samples were collected from each season. A total of 90 samples were collected during the study from 15 sacred groves. Spiders were collected in the morning from 7.00 am to 10.00 am and evening from 4.00 pm to 7.00 pm. Line transect method (Lubin, 1978) were adopted in this study. A total of 30 fixed transects (100 m in length) were established across the 15 sacred groves. Spiders were collected along 100 m transect length of two transects per habitat. Each transect was sampled 1 hour, thus adding up to 1-2 hours for a study area. Standard sampling techniques such vegetation beating, litter sampling, ground hand collection, aerial hand collection, and sweep netting were employed to collect the spiders from their own habitats. To avoid the edge effect, transects were fixed 25 m inside from the boundary.

All collected specimens were kept in separate vials with proper labelling and other notes of taxonomic importance. They were sorted and an effort was made to identify live specimen using reference books like Sebastian & Peter (2009) up to at least family or genus level and recorded from the field itself. They were preserved in 70% ethyl alcohol. Some adults of each species or morpho-species were preserved as voucher specimen with proper cataloguing. Comparatively large specimens were photographed with the help of special digital camera and lens (Canon EOS 5D digital SLR and Canon 180 mm macro lens). Preserved specimens were examined under a stereo zoom microscope (Leica-M205C) in the laboratory for taxonomic identification. They were subjected to detailed taxonomic examination. Adult specimens were identified by the detailed examination of genital structures like epigyne and palp. Juveniles also identified by morphological examination by using standard literature (Sebastian & Peter, 2009; Tikader, 1987; Barrion & Litsinger, 1995; Jocqué & Dippenaar-Schoeman, 2006).

The abundance-based data were analysed with SpadeR package version 0.1.1 (Species Prediction and Diversity Estimation, Chao & Chiu, 2016) and iNEXT package 2.0.9 (Hsieh *et al.*, 2016; Chao *et al.*, 2014) also give the 95% confidence intervals to define the sampling variation, constructed using 200 bootstrap replications (Chao, 1987; Chao & Chiu, 2016). The relative abundance based Morisita-Horn dissimilarity index (q=1) was used to find the overall and the pairwise dissimilarities of the five habitats, using the SpadeR package (Chao & Chiu, 2016). Regional diversity analysis was done by using a non-parametrical test called Wilcoxon rank sum test.

Table 3. Diversity parameters of the two regions.

VARIABLES	KASARGOD	KANNUR
Total individuals	2904.00	8404.00
Species richness	109.00	220.00
Estimated richness ± se	122.60±8.17	227.38±4.36
Mean richness ± sd	15.44±6.02	39.64±9.04
Mean abundance ± sd	60.50±41.34	200.10±67.89
Average observed Shannon ± sd	10.31±3.60	24.05±8.01
Average Simpson Diversity	7.85	16.64
Observed Simpson sd	2.77	6.54
Singleton	17.00	19.00
Doubleton	13.00	23.00

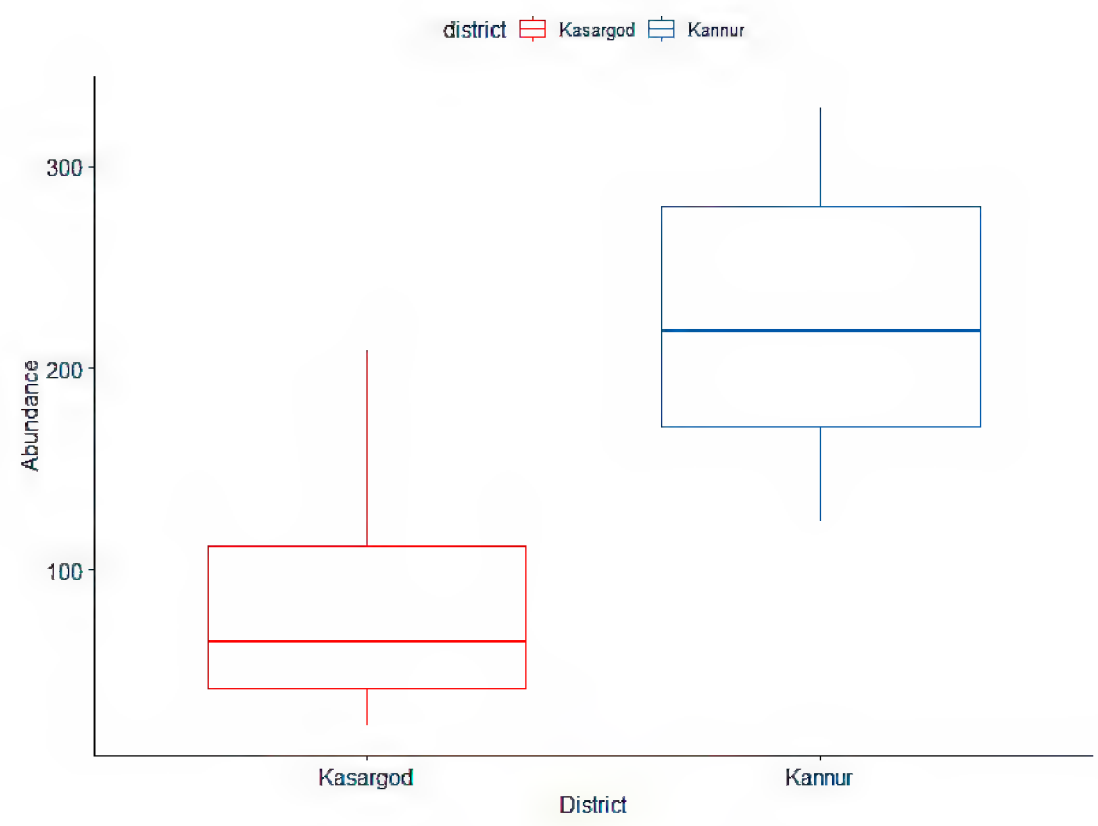


Fig. 3. Box plots showing the abundance of spider assemblages in Kasargod and Kannur districts.

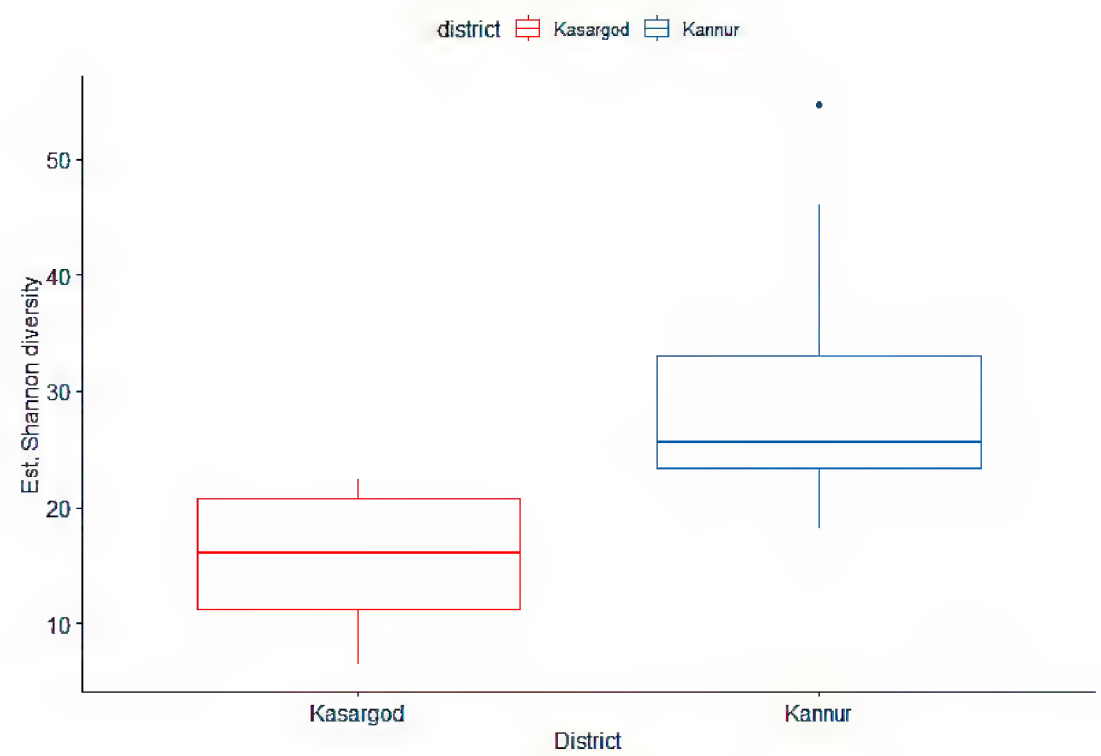


Fig. 4. Box plots showing the estimated Shannon diversity of spider assemblages in Kasargod and Kannur districts.

Results

This study assesses diversity in the study areas located in two districts (Kasargod and Kannur) of northern Kerala. Analyzing different facets of local diversity (abundance and diversity) and the contribution of species differentiation (beta diversity) among localities and habitat types to the composition of regional diversity. This study found 11308 individuals of 257 spider species/ morpho-species. Local diversity differs among two sampled localities. At the habitat level, the different facets of biodiversity followed a clear pattern, where sacred grove spiders of Kannur have higher abundance and diversity than Kasargod.

Abundance and Diversity

Abundance and variation of species diversity (Shannon index) follow the same trend. A total of 2904 individuals with 109 species were collected from Kasargod district

and 8404 individuals with 220 species were collected from Kannur district. Singletons and doubletons were higher in Kannur district (19 and 23) and other variables are represented in Table (3). For testing hypothesis, we took 4 evergreen habitats from both districts to compare diversity, whether there is any significant difference in the abundance and estimated Shannon diversity among samples from two districts. Wilcoxon rank sum test was used to test the hypothesis. Sacred groves of Kannur district have significantly higher values of abundance (Fig. 3) and diversity (Fig. 4). Result of the test was $p < 0.001$, for abundance ($w=13.5$, $p=1.594e-08$) and diversity ($w=25$, $p=6.21e-08$), so these regions show a significant variation (Figs. 3 & 4).

Beta diversity

The overall similarity in Kannur district was 80.01%, with a 95% confidence interval of 79.25% and 80.77%. Overall similarity of Kasargod district was 79.12%, with a 95% confidence interval of 77.80% and 80.44% (Tables 4 & 5). The similarity between the two districts were 68.58% with a 95% confidence interval of 66.65% and 70.50%.

Table 4. Overall similarity within group.

Regions	Estimate	se	95%LCL	95%UCL
Horn size weighted (q=1) Kasargod	0.7912702	0.006722607	0.7780938	0.8044465
Horn size weighted (q=1) Kannur	0.8001879	0.003874392	0.7925941	0.8077817

Table 5. Similarity between groups.

	Estimate	se	95%LCL	95%UCL
Horn size weighted (q=1)	0.6858151	0.009833422	0.6665416	0.7050886

Discussion

The geographical and climatic patterns have a crucial role in spider assemblages. Analysis of different facets of regional diversity in sacred groves of Kannur and Kasargod districts shows significant difference. A clear difference present in between climatic, geographical features and elevation pattern in both districts. Kannur experiences a rare humid tropical monsoon climate and has an elevation of 1.02 metres (2.98 ft). Kasargod has a tropical climate and has an average elevation of 19 metres (62 ft). Analyzing different facets of local diversity (abundance and diversity), and the contribution of species differentiation (β diversity) among localities and habitat types is very important to determine the composition of regional diversity. At the habitat level, the different facets of biodiversity followed a clear pattern, where sacred grove spiders of Kannur than Kasargod. Land management strategy design incorporating patterns of spider diversity at an appropriate regional scale is essential for the spider biodiversity conservation (New, 1999). It is feasible starting from the local knowledge of the diversity considering that this has a high correlation with the vegetation complexity that appears as a powerful predictor of the local spider species richness on a regional scale (Jiménez-Valverde & Lobo, 2007).

In sacred groves, the presence of contrasting habitats and the variation between localities have a great influence in orb-weaving spider communities, leading to an important contribution of beta diversity to the regional spider species richness. Management for conservation in the sacred groves should be directed towards promoting natural spatial heterogeneity, giving special emphasis to habitat mosaics in different

localities (Rubio & Moreno, 2010). However, to provide a better framework for conservation management, other biological groups should be studied. Moreover, microhabitat variables and disturbance effects should also be investigated because they may stand for important factors influencing diversity, especially in order to assess the potential anthropogenic activities in this type of protected areas.

Many more habitats have to be studied until the relationship between local and regional species pool of spiders can be understood. This study has considered diversity in spider assemblages with respect to sample size and habitat heterogeneity. However, other factors such as productivity, latitudinal gradient and size of the regional species pool have been suggested to influence species richness (Huston & Huston, 1994; Koleff & Gaston, 2002). It was not possible to assess the impact of these factors quantitatively because only limited sites per habitat type were sampled. But with its emphasis on the diversity patterns at small scale the present study may help to outline ideas for design of monitoring programmes and future inventories.

This study revealed that the value of different habitats will depend on their size and location. The amount of under story vegetation has a strong influence on spider abundance and diversity, thus affecting the amount of habitat available to spider occurrence. Therefore, diversity can be maintained as far as suitable habitat structure is provided. So that spiders can perceive the connectivity of different habitats. Studies revealed that optimum species richness influence habitat heterogeneity (Uniyal & Hore, 2008). This allows a narrow niche separation (Bonn & Kleinwächter, 1999), hence benefiting the persistence of species with divergent habitat preferences and interrelated sets of species traits. This study recommends that the spider fauna of sacred groves is rich and useful for monitoring work, and that support for the conservation of this area should be continued. More individual spider species need to be studied in order to evaluate their indicator values that would help in establishment of a longer list of indicator species for sacred grove management. Thus, it might be wise to extend this survey to other parts of Kerala, since it might increase the number of known species in this ecosystem.

Acknowledgments

The authors are thankful to Fr. Dr. Jolly Andrews, Principal, Christ College, Irinjalakuda, Kerala, India, for providing necessary facilities for this research. We are deeply acknowledging the authorities of different sacred groves of Kannur and Kasargod districts for providing the permission for sample collection and this study was funded by e-grantz: SC-ST Development Department, Government of Kerala, India.

References

Barrion, A.T. & Litsinger, J.A. 1995. *Riceland spiders of South and Southeast Asia*. CAB International Wallingford, UK, xix + 700 pp.

Bonn, A. & Kleinwächter, M. 1999. Microhabitat distribution of spider and ground beetle assemblages (Araneae, Carabidae) on frequently inundated river banks of the River Elbe. *Zeitschrift für Ökologie und Naturschutz*, 8(3): 109-123.

Borges, P.A. & Brown, V.K. 2004. Arthropod community structure in pastures of an island archipelago (Azores): looking for local-regional species richness patterns at fine-scales. *Bulletin of Entomological Research*, 94(2): 111-121.

Chandran, M.S., Gadgil, M. & Hughes, J.D. 1998. *Sacred groves of the Western Ghats of India. Conserving the Sacred for Biodiversity Management*, pp. 211-231.

Chao, A. 1987. Estimating the population size for capture-recapture data with unequal catchability. *Biometrics*, 43(4): 783-791.

Chao, A. & Chiu, C-H. 2016. Nonparametric estimation and comparison of species richness. In: eLS. John Wiley & Sons, Ltd: Chichester. [*Ecology letters*, 1-11.]

Chao, A., Gotelli, N.J., Hsieh, T.C., Sander, E.L., Ma, K.H., Colwell, R.K. & Ellison, A. M. 2014. Rarefaction and extrapolation with Hill numbers: a framework for sampling and estimation in species diversity studies. *Ecological Monographs*, 84(1): 45-67.

Collins, S.L., Glenn, S.M. & Briggs, J.M. 2002. Effect of local and regional processes on plant species richness in tallgrass prairie. *Oikos*, 99(3): 571-579.

Hsieh, T.C., Ma, K.H. & Chao, A. 2016. iNEXT: interpolation and extrapolation for species diversity. R package version 2.0.8, URL: http://chao.stat.nthu.edu.tw/blog/software-download.

Huston, M.A. 1994. *Biological diversity: The coexistence of species on changing landscapes*. xix+681 pp. Cambridge University Press.

Jiménez-Valverde, A. & Lobo, J.M. 2007. Threshold criteria for conversion of probability of species presence to either-or presence-absence. *Acta oecologica*, 31(3): 361-369.

Jocqué, R. & Dippenaar-Schoeman, A.S. 2006. *Spider families of the world*. Musée Royal de l'Afrique Central Tervuren, 336 pp.

Kapoor, V. 2006. An assessment of spider sampling methods in tropical rainforest fragments of the Anamalai Hills, Western Ghats, India. *Zoo's Print*, 21: 2483-2488.

Koleff, P. & Gaston, K.J. 2002. The relationships between local and regional species richness and spatial turnover. *Global Ecology and Biogeography*, 11(5): 363-375.

Lubin, Y.D. 1978. Seasonal abundance and diversity of web-building spiders in relation to habitat structure on Barro Colorado Island, Panama. *Journal of Arachnology*, 6(1): 31-51.

New, T.R. 1999. Untangling the web: spiders and the challenges of invertebrate conservation. *Journal of Insect Conservation*, 3: 251-256.

Pai, D.S., Sridhar, L., Rajeevan, M., Sreejith, O.P., Satbhai, N.S. & Mukhopadhyay, B. 2014. Development of a new high spatial resolution (0.25° × 0.25°) long period (1901-2010) daily gridded rainfall data sets over India and its comparison with existing data sets over the region. *Mausam*, 65(1): 1-18.

Rubio, G.D. & Moreno, C.E. 2010. Orb-weaving spider diversity in the Iberá Marshlands, Argentina. *Neotropical Entomology*, 39(4): 496-505.

Sebastian, P.A. & Peter, K.V. 2009. *Spiders of India*. Orient Blackswan, Universities Press, Hyderabad. 734 pp.

Srivastava, D.S. 1999. Using local-regional richness plots to test for species saturation: pitfalls and potentials. *Journal of Animal Ecology*, 68(1): 1-16.

Sumesh, N.V. & Sudhikumar, A.V. 2020. Checklist of spiders from the sacred groves of Northern Kerala, India. *Uttar Pradesh Journal of Zoology*, 41(9): 104-115.

Tikader, B.K. 1987. *Handbook of Indian Spiders*. Zoological Survey of India, Calcutta, 251 pp.

Uniyal, V.P. & Hore, U. 2008. Spider assemblage in the heterogeneous landscape of Terai Conservation Area, India. *Revista Ibérica de Aracnología*, 15: 89-95.

Wise, D.H. 1993. *Spiders in ecological webs.* Cambridge University Press, New York, 344 pp.

Serket (2021) vol. 17(4): 438-473.

Faunal diversity of Gnaphosidae (Arachnida: Araneae: Araneomorphae) in India: An updated Checklist

Rajendra Singh [1*] & Garima Singh [2]
[1] Department of Zoology, Deendayal Upadhyay University of Gorakhpur, U.P., India
[2] Department of Zoology, University of Rajasthan, Jaipur, Rajasthan, India
[*] Corresponding author e-mail address: rsinghpu@gmail.com

Abstract

Checklist of faunal biodiversity of the ground spiders, Gnaphosidae, in different states of India and the union territories is presented herewith. A total of 174 species kept under 35 genera of Gnaphosidae were recorded in all states and the union territories of India except for Nagaland, Sikkim, and Telangana and three union territories, Dadra & Nagar Haveli and Daman & Diu, Delhi and Lakshadweep, out of which 124 species (71.3%) were strictly endemic. However, among them, 8 species seem to be the case of erroneous report or misidentification. Two genera of ground spiders are highly speciose, e.g. *Drassodes* Westring, 1851 (31 species) and *Zelotes* Gistel, 1848 (30 species). A maximum of 66 species of these ground spiders were recorded from Maharashtra followed by 43 species from Gujarat, 38 species from Madhya Pradesh, 35 species from Chhattisgarh, 32 species from Uttar Pradesh, 25 species each from Rajasthan and Jammu & Kashmir, 24 species from Uttarakhand, 21 species from West Bengal, 20 species from Himachal Pradesh, 17 species from Karnataka, 15 species from Tamil Nadu, 14 species from Kerala, 12 species each from Odisha and Punjab, 10 species from Andhra Pradesh and less than 10 species were recorded from other states. Five species are considerably widely distributed (in 10 or more states and union territories), viz. *Drassodes himalayensis* Tikader & Gajbe, 1975 (11 states, 1 union territory), *Drassodes luridus* (O. Pickard-Cambridge, 1874) (11 states), *Poecilochroa barmani* Tikader, 1982 and *Zelotes sataraensis* Tikader & Gajbe, 1979 (10 states). Several species of Gnaphosidae reported from India are recorded only from one state or from the type locality. Hence, extensive faunistic surveys for these spiders are required throughout the country.

Keywords: Gnaphosidae, checklist, faunal distribution, ground spiders, India.

Introduction

The spiders (Arthropoda: Chelicerata: Arachnida: Araneae) are among the most frequent and abundant predators in the terrestrial ecosystems throughout the world having a very diverse range of lifestyles and foraging behaviours consuming about 400-800 million tons of prey (mostly insects) globally per year; and also serve as a food source for other carnivores (Nyffeler & Birkhofer, 2017). Presently, spiders consist of 49,483 species placed in 4,217 genera belonging to 129 families (World Spider Catalog, 2021). Despite recent researches on the faunistic biodiversity surveys of Indian spiders, their number is meagre, only 1867 species belonging to 475 genera (Caleb & Sankaran, 2021) in spite of having very rich biodiversity and a tropical climate with biodiversity hotspots. Recently, the species distribution and checklist of 65 families of spiders have been updated in India (Sharma *et al.*, 2020a, b, 2021; Singh, B. *et al.*, 2020, 2021; Singh, 2021a, b, c, d, e; Singh & Singh, 2020, 2021a, b; Singh *et al.*, 2020a, b, c, d, e, f, 2021a, b; Tiwari & Singh, 2021; Tiwari *et al.*, 2021a, b, c).

Gnaphosidae Banks, 1892 is one of the families of spiders which are globally distributed. These spiders are commonly known as the ground spiders and are presently the fourth largest family with 2565 known species in 162 genera after Salticidae (6344 species, 658 genera), Linyphiidae (4695 species, 624 genera) and Araneidae (3065 species, 177 genera) (World Spider Catalog, 2021). These are araneomorph, entelegyne (females have a genital plate), and stout ecribellate (spin sticky seizure silk) spiders with a flattened and elongate abdomen. They are usually 2-18 mm in length. One of the characteristic features of the ground spiders is their cylindrical and parallel spinners, the anterior pair being slightly longer, and more heavily sclerotized than the posterior pair. The eight eyes are arranged in two rows; the posterior median eyes are often not round, but oval, triangular or reduced to slits. The chelicerae are strong, and the fang furrows are provided with teeth. The endites usually have an oblique or transverse depression. The ground spiders are also distinguished by having two tarsal claws, claw tufts, and scopulae. The body is covered with short sleek hairs. The ground spiders have the piriform gland spigots homogeneous in morphology and clearly longer and wider than the major ampullate gland spigots in both males and females. Usually, the base of the piriform gland spigots is shorter or about the same size as the shaft, but in some cases, the base might be longer than the shaft (Azevedo *et al.*, 2018). The ground spiders are usually found at ground level in open habitats but few species, e.g. *Scotophaeus blackwalli* (Thorell, 1871) are found in human dwellings. They are unable to construct web to capture prey and generally hunt by active foraging, chasing down and restraining individual preys on the surface mostly at night and hide during the day in such places as under rocks, under logs and in leaf litter usually in a tubular silken retreat. However, species of *Micaria* Westring, 1851 are diurnal hunters running rapidly about in bright sunshine. The ground spiders, during hunting, produce thick, gluey silk from their enlarged spinnerets and use it to entrap their prey in wrapping attacks and immobilize potential prey even proportionally large preys (Wolff *et al.*, 2017). The females safeguard the egg sacs until the spiderlings hatch. Recently, Azevedo *et al.* (2018) have discussed the systematics and evolution of ground spiders, relationships among the Gnaphosidae genera using morphological characters, the monophyly of internal groupings and subfamilies, as well as the relationship of the family with other spider families.

Information regarding the Indian Gnaphosidae is insufficient and highly incoherent primarily due to the unexplored diversity of these spiders in several parts of the country like other families of spiders (Sharma *et al.*, 2020a, b; Singh *et al.*, 2020a, b, c, d, e, f). There are several species of these spiders yet to be described and several

species recorded from India have also been misidentified as they are said to be identified by using existing old literature without a re-examination of the corresponding type material and without consulting any spider taxonomist. Hence, these reports need re-examination. At present the faunal survey results of ground spiders are all scattered in the literature and so far no updated consolidated account is available regarding their distribution pattern across the country. Therefore, this present work was carried out to make available an up-to-date checklist of Indian Gnaphosidae like other families (Singh, 2021a, b, c, d; Singh & Singh, 2021a, b; Tiwari *et al.*, 2021a, b) in different states and the union territories of India.

Material and Methods

This checklist is based on the published literature in recent past books, book chapters, journals, proceedings, few authentic theses, websites, and World Species Catalog (World Spider Catalog, 2021) up to May 20, 2021. Some references to the faunistic surveys by Indian authors were omitted because of the repetition of the location. In most of the literature published earlier, several errors crept in the scientific names of the spiders even in the recent ones. This occurred because such information soon become obsolete and, due to their perceived understanding, readers occasionally do not take into account new sources of data. The researches on spider taxonomy like other taxa are continued with the description of new taxa, their modified status, and the publication of other nomenclatural decisions and clarifications (World Spider Catalog, 2021; Singh, 2021a, b, c, d). If a spider species is identified only up to a generic level, it was considered as species if no other species of that genus is reported within the state. In the present checklist, attempts have been made to correct the errors in the scientific names of the spiders following the World Spider Catalog (2021). Only those synonymies were mentioned that were reported in India, for other synonymies, the World Spider Catalog (2021) may be consulted. Only those species were considered endemic that were exclusively found only in India and such species are marked with (*). If the spider species is not endemic, its elsewhere distribution is also furnished following the World Spider Catalog (2021) and other sources of literature. Seemingly, misidentified and erroneous records are marked with (♦).

Results and Discussion

In India, probably Blackwall (1867) was the first to describe the first ground spider, *Drassodes delicatus* either from Delhi, Agra, or Meerut (Uttar Pradesh). After seven years, O. Pickard-Cambridge (1874) described five species, *Drassodes astrologus*, *Drassodes cambridgei* (as *Drassus ferrugineus*), *Drassodes luridus*, *Drassodes macilentus*, and *Nomisia harpax* from Maharashtra. *Drassodes cambridgei* (Roewer, 1951) is a replacement name due to preoccupied name. After a decade, Simon (1884) described two species of the ground spiders, *Prodidomus chaperi* and *Zimiris indica* (a synonym of *Zimiris doriae* Simon, 1882) from Tamil Nadu. Thereafter, again O. Pickard-Cambridge (1885) described four more species, two from Jammu & Kashmir (*Drassodes dispulsus*, *Drassodes involutus*) and two from Ladakh (*Coreodrassus interlisus*, *Echemus interemptor*). In the same year, Simon (1885) described two more species of ground spiders, *Echemus chaperi* and *Zelotes pexus* from Karnataka. In 19th century, seven more species were described by Thorell (1891) and Simon (1897a, b), viz. *Poecilochroa behni* Thorell, 1891 from Andaman & Nicobar Islands; *Drassodes cerinus* Simon, 1897

from Gujarat (Simon, 1897a); *Ladissa inda* (Simon, 1897), *Zelotes hospitus* (Simon, 1897) and *Zelotes univittatus* (Simon, 1897) from Maharashtra (Simon, 1897b).

At the beginning of the 20th century, Simon (1905) described two species of ground spiders, *Drassodes heterophthalmus* Simon, 1905 and *Zelotes maindroni* (Simon, 1905) from Tamil Nadu and recorded a few ones; and Strand (1907) described *Scotophaeus merkaricola* Strand, 1907 from Karnataka. After a decade, Sherriffs (1919) recorded three species of ground spiders from Kerala and Tamil Nadu. After about two decades, Caporiacco (1934, 1935) described and recorded several species of ground spiders from Jammu & Kashmir and Ladakh and Reimoser (1934) described one species from Tamil Nadu. Among the Indian authors, Bhattacharya (1935) was the first to describe a ground spider species *Micaria faltana* from West Bengal. Later, several authors (Tikader, 1962, 1966, 1973, 1977, 1982; Cooke, 1972; Patel & Patel, 1975; Tikader & Gajbe, 1975; 1976a, b, c, 1977a, b, c, d, 1979; Platnick, 1976a, b; Gajbe, 1979, 1984, 1987a, b, c, d, 1989, 1992a, b, 1993a, b, c, d; Biswas, 1984; Gajbe & Rane, 1985; Patel, 1988a, b, 1989; Biswas & Biswas, 1992; Nigam & Patel, 1996; Gajbe & Gajbe, 1999) described and recorded more than one hundred species of ground spiders from several geographic regions of India. Long back, Tikader (1982) and Biswas (1987) compiled the Gnaphosidae of India and Odisha, respectively.

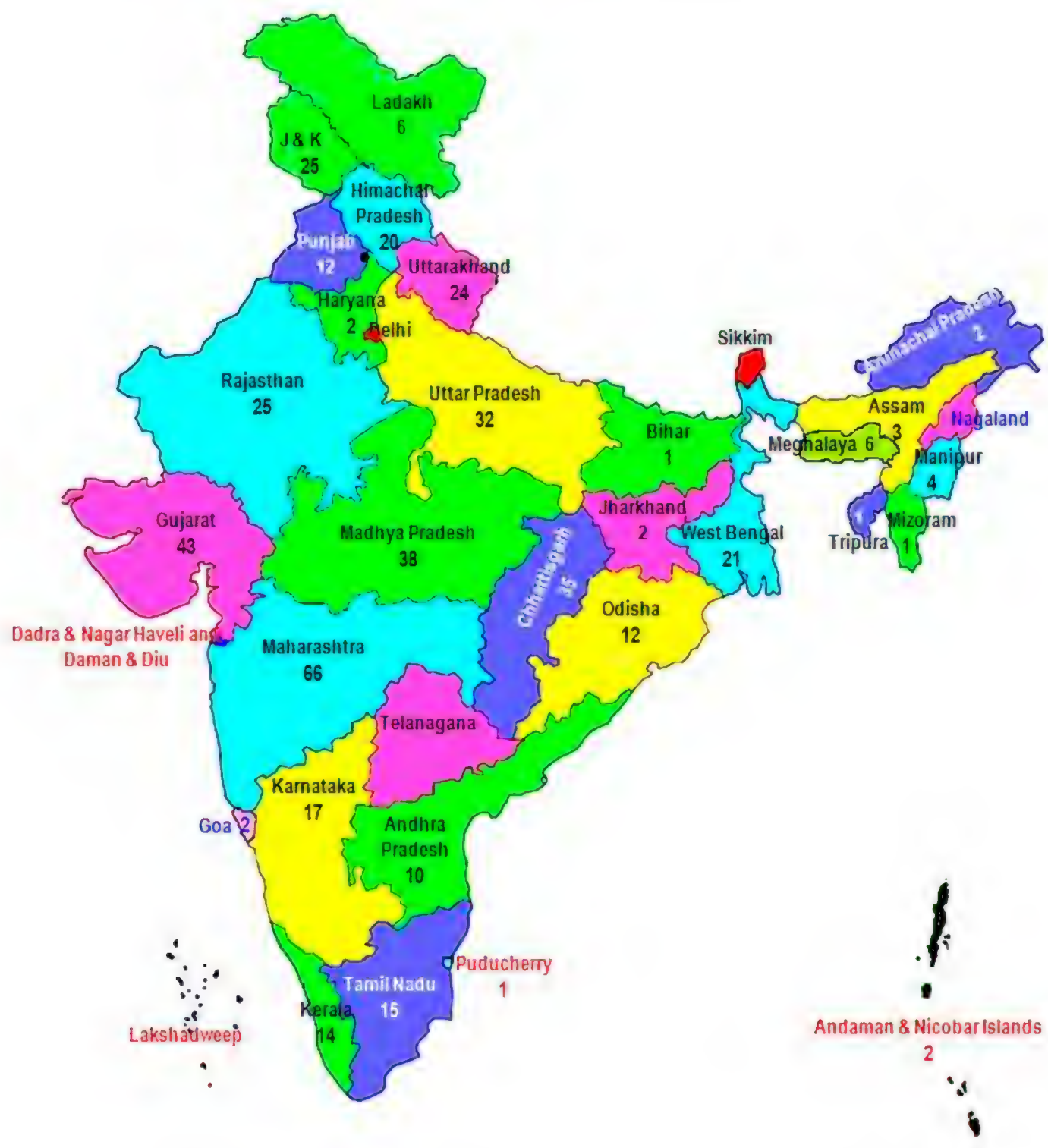


Fig. 1. Number of species of ground spiders (Gnaphosidae) in Indian states and the union territories.

In the present century, 12 species of Gnaphosidae were described from India, three species each from Chhattisgarh (*Drassodes narayanpurensis* Gajbe, 2005; *Zelotes viveki* Gajbe, 2005; *Zelotes yogeshi* Gajbe, 2005) and Kerala (*Synaphosus iunctus* Sankaran & Sebastian, 2018; *Urozelotes patulusus* Sankaran & Sebastian, 2018; *Zimiris diffusa* Platnick & Penney, 2004), two species each from Madhya Pradesh (*Sosticus jabalpurensis* Bhandari & Gajbe, 2001; *Zelotes bharatae* Gajbe, 2005) and Tamil Nadu (*Poecilochroa tridotus* Caleb & Mathai, 2013; *Zelotes tambaramensis* Caleb & Mathai, 2013, and one species each from Karnataka (*Heser vijayanagara* Bosselaers, 2010) and Uttarakhand (*Gnaphosa kankhalae* Biswas & Roy, 2008). Several authors have recorded many species of Gnaphosidae across India. Recently, Sankaran *et al.* (2019, 2020a, b, 2021) discussed the taxonomic validity of seven genera of Gnaphosidae, viz. *Apodrassodes* Vellard, 1924, *Drassyllus* Chamberlin, 1922, *Herpyllus* Hentz, 1832, *Nodocion* Chamberlin, 1922, *Phaeocedus* Simon, 1893, *Scopoides* Platnick, 1989, and *Sergiolus* Simon, 1892.

At present, 174 species belonging to 35 genera were described or recorded from India during the last 154 years (1867-2021), out of which, 124 species (71.3%) were strictly endemic, i.e. described and recorded only in India while few more species were described from India but were also recorded in neighbouring countries. However, the Indian record is only 6.8% of the world Gnaphosidae fauna (2562 species placed in 162 genera (World Spider Catalog, 2021). All these spiders were distributed in all Indian states except Nagaland, Sikkim and Telangana, and three union territories, Dadra and Nagar Haveli and Daman and Diu, Delhi and Lakshadweep (Fig. 1). Eight species marked with (♦) seem to be erroneous reports or misidentifications. The monotypic genus *Melicymnis* Simon, 1885 described and recorded in India is considered nomen dubium (World Spider Catalog, 2021). One of the species, *Drassodes invisus* (O. Pickard-Cambridge, 1885) is reported to be distributed in India (Marusik & Omelko, 2019; Caleb & Sankaran, 2021; World Spider Catalog, 2021) but it was collected by the author O. Pickard-Cambridge (1885) between Sirikol and Aktalla which is probably located somewhere in Pamir mountain area and its synonym *Drassus lapsus* O. Pickard-Cambridge, 1885 was also collected from Yangihassar (China) (Pickard-Cambridge, 1885). Since then, no other record is available in literature. Thus, its distribution in India seems to be incorrect. Hence, this species is not listed in this checklist. Caleb & Sankaran (2021) recently enlisted only 154 species of Gnaphosidae described under 28 genera and the rest of the species recorded in India are either overlooked by them or are cases of misidentification and erroneous reports.

Two genera of ground spiders are highly speciose, e.g. *Drassodes* Westring, 1851 (31 species) and *Zelotes* Gistel, 1848 (30 species). A maximum of 66 species of these ground spiders was recorded from Maharashtra followed by 43 species from Gujarat, 38 species from Madhya Pradesh, 35 species from Chhattisgarh, 32 species from Uttar Pradesh, 25 species each from Rajasthan and Jammu & Kashmir, 24 species from Uttarakhand, 21 species from West Bengal, 20 species from Himachal Pradesh, 17 species from Karnataka, 15 species from Tamil Nadu, 14 species from Kerala, 12 species each from Odisha and Punjab, 10 species from Andhra Pradesh and less than 10 species were recorded from other states (Fig. 1). No species of ground spiders is recorded from Nagaland, Sikkim and Telangana and three union territories, Dadra and Nagar Haveli and Daman and Diu, Delhi and Lakshadweep. Indeed, no survey was conducted in these regions and they need an extensive faunistic survey. Out of 174 species of Gnaphosidae recorded from India, 5 species are considerably widely distributed (in 10 or more states and union territories), viz. *Drassodes himalayensis* Tikader & Gajbe, 1975 (11 states, 1 union territory), *Drassodes luridus* (O. Pickard-Cambridge, 1874) (11 states),

Poecilochroa barmani Tikader, 1982, and *Zelotes sataraensis* Tikader & Gajbe, 1979 (10 states). Several species of Gnaphosidae reported from India are recorded only from one state or from the type locality. Hence, extensive faunistic surveys for these spiders are required throughout the country. Following is the detailed list of these spiders distributed in Indian states and union territories and elsewhere:

I. Checklist of ground spiders (Gnaphosidae) in Indian States and Union Territories

1. *Aphantaulax trifasciata* (O. Pickard-Cambridge, 1872)
• Karnataka (Prashanthakumara & Venkateshwarlu, 2017)
Elsewhere: Asia, Caucasus, China, France, Greece, Hungary, Iran, Israel, Italy, Japan, Kazakhstan, North Africa, Russia, Syria, Turkey.

2. *Berlandina drassodea* (Caporiacco, 1934) *
• Jammu & Kashmir (Caporiacco, 1934, 1935)

3. *Berlandina plumalis* (Pickard-Cambridge, 1872)
Syn. *Pythonissa passerina* Simon, 1884
• Jammu & Kashmir (Caporiacco, 1935)
• Tamil Nadu (Simon, 1905)
Elsewhere: Afganistan, France, Greece, Iran, Israel, Libya, Myanmar, North Africa, Palestine, Syria.

4. *Berlandina* sp.
• Karnataka (Abhijith, 2019)

5. *Callilepis chakanensis* Tikader, 1982 *
• Chhattisgarh (Gajbe, 2003a; Kujur & Ekka, 2012; Ekka & Kujur, 2015)
• Madhya Pradesh (Gajbe, 2003a)
• Maharashtra (Tikader, 1982)

6. *Callilepis ketani* Gajbe, 1984 *
• Chhattisgarh (Gajbe & Sharma, 1994; Kujur & Ekka, 2016)
• Karnataka (Gajbe, 1988, 2005)
• Madhya Pradesh (Gajbe, 1988, 2005; Gajbe, 2003a, b; Patil, 2012)
• Maharashtra (Rithe, 2012)
• Punjab (Gajbe, 1988; Gajbe, 2005)
• Rajasthan (Gajbe, 1984; Lawania & Trigunayat, 2015)
• Uttar Pradesh (Lawania & Mathur, 2014a, b, c)

7. *Callilepis lambai* Tikader & Gajbe, 1977 *
• Chhattisgarh (Gajbe & Sharma, 1994; Kujur & Ekka, 2016)
• Jammu & Kashmir (Chandra *et al.*, 2021)
• Karnataka (Tikader & Gajbe, 1977a; Tikader, 1982; Gajbe, 1988, 2005)
• Madhya Pradesh (Gajbe, 1988, 2005; Gajbe, 2003a, b; Patil, 2012)
• Maharashtra (Rithe, 2012)
• Punjab (Gajbe, 1988; Gajbe, 2005)
• Rajasthan (Lawania & Trigunayat, 2015)
• Uttar Pradesh (Lawania & Mathur, 2014a, b, c)

8. *Callilepis pawani* Gajbe, 1984 *
• Jharkhand (Gajbe, 1984)
• Maharashtra (Rithe, 2012)

9. *Callilepis rajani* Gajbe, 1984 *

• Maharashtra (Rithe, 2012)
• Uttarakhand (Gajbe, 1984)

10. *Callilepis rajasthanica* Tikader & Gajbe, 1977 *
Syn. *Callilepis rajasthanicus* Tikader & Gajbe, 1977
• Rajasthan (Tikader & Gajbe, 1977a; Tikader, 1982; Jangid *et al.*, 2019)

11. *Callilepis rukminiae* Tikader & Gajbe, 1977 *
• Chhattisgarh (Kujur & Ekka, 2016)
• Jammu & Kashmir (Chandra *et al.*, 2021)
• Madhya Pradesh (Gajbe, 2003a, b; Patil, 2012)
• Maharashtra (Tikader & Gajbe, 1977a; Tikader, 1982; Gajbe, 1988; Meshram, 2011; Rithe, 2012)
• Rajasthan (Gajbe, 1988; Lawania & Trigunayat, 2015)
• Tamil Nadu (Gajbe, 1988; Karthikeyani *et al.*, 2017)
• Uttar Pradesh (Lawania & Mathur, 2014a, b, c)

12. *Callilepis* sp.
• Gujarat (Siliwal *et al.*, 2003a)
• Jammu & Kashmir (Khan, 2009; Punjoo & Bhat, 2015)
• Madhya Pradesh (Gajbe, 2004)
• Rajasthan (Malhotra *et al.*, 2019)

13. *Camillina smythiesi* (Simon, 1897) *
Syn. *Echemus smythiesi* Simon, 1897; *Haplodrassus smythiesi* (Simon, 1897)
• Uttarakhand (Simon, 1897a; Tikader, 1982)

14. *Camillina* sp.
• Gujarat (Yadav *et al.*, 2017)

15. *Coillina yogeshi* (Gajbe, 1993)
Syn. *Apodrassodes yogeshi* Gajbe, 1993
• Tripura (Gajbe, 1993a)
Elsewhere: China.

16. *Coreodrassus interlisus* (O. Pickard-Cambridge, 1885)
Syn. *Drassus interlisus* O. Pickard-Cambridge, 1885
• Ladakh (Pickard-Cambridge, 1885)
Elsewhere: China.

17. *Cryptodrassus khajuriai* (Tikader & Gajbe, 1976) *
Syn. *Drassyllus khajuriai* Tikader & Gajbe, 1976; *Drassyllus jabalpurensis* Gajbe, 2005
• Chhattisgarh (Kujur & Ekka, 2012; Ekka & Kujur, 2015)
• Madhya Pradesh (Tikader & Gajbe, 1976a; Tikader, 1982; Gajbe, 1988; Gajbe, 2003a; Gajbe, 2005, 2007; Sankaran *et al.*, 2020a)

18. *Cryptodrassus mahabalei* (Tikader, 1982) *
Syn. *Drassyllus mahabalei* Tikader, 1982
• Gujarat (Yadav, 2019)
• Madhya Pradesh (Tikader, 1982; Gajbe, 2005, 2007)
• Maharashtra (Gajbe, 2003a; Gajbe, 2005; Sankaran *et al.*, 2020a)

19. *Cryptodrassus platnicki* (Gajbe, 1987) *
Syn. *Drassyllus platnicki* Gajbe, 1987
• Maharashtra (Gajbe, 1987a; Sankaran *et al.*, 2020a)

20. *Cryptodrassus ratnagiriensis* (Tikader & Gajbe, 1976) *
Syn. *Drassyllus ratnagiriensis* Tikader & Gajbe, 1976
• Maharashtra (Tikader & Gajbe, 1976a; Tikader, 1982; Sankaran *et al.*, 2020a)

21. *Drassodes andamanensis* Tikader, 1977 *
• Andaman & Nicobar Islands (Tikader, 1977; Tikader, 1982)

22. *Drassodes astrologus* (O. Pickard-Cambridge, 1874) *
Syn. *Drassus astrologus* O. Pickard-Cambridge, 1874
• Maharashtra (Pickard-Cambridge, 1874)
• Odisha (Choudhury *et al.*, 2019)

23. *Drassodes cambridgei* Roewer, 1951 *
Syn. *Drassus ferrugineus* O. Pickard-Cambridge, 1874; *Drassodes ferrugineus* (O. Pickard-Cambridge, 1874): specific name was erroneously attributed to Blackwall, 1861 by Tikader, 1982)
• Maharashtra (Pickard-Cambridge, 1874; Simon, 1905; Roewer, 1951; Tikader, 1982)

24. *Drassodes carinivulvus* Caporiacco, 1934 *
• Jammu & Kashmir (Caporiacco, 1934, 1935; Tikader, 1982)
• Kerala (Adarsh & Nameer, 2016)

25. *Drassodes cerinus* Simon, 1897 *
• Gujarat (Simon, 1897a)

26. *Drassodes clavifemur* (Reimoser, 1935) *
Syn. *Sillemia clavifemur* Reimoser, 1935
• Jammu & Kashmir (Reimoser, 1935)

27. *Drassodes delicatus* (Blackwall, 1867) *
Syn. *Drassus delicatus* Blackwall, 1867
• Kerala (Smitha & Sudhikumar, 2020)
• Uttar Pradesh (Blackwall, 1867)

28. *Drassodes deoprayagensis* Tikader & Gajbe, 1975 *
• Himachal Pradesh (Tikader, 1982; Gajbe, 1988)
• Maharashtra (Meshram, 2011; More & Sawant, 2013)
• Uttarakhand (Tikader & Gajbe, 1975; Tikader, 1982; Gajbe, 1988)

29. *Drassodes dispulsus* (O. Pickard-Cambridge, 1885)
Syn. *Drassodes dispulsus* O. Pickard-Cambridge, 1885
• Jammu & Kashmir (Pickard-Cambridge, 1885; Caporiacco, 1935)
• Ladakh (Pickard-Cambridge, 1885)
Elsewhere: China, Afghanistan/Tajikistan?

30. *Drassodes gangeticus* Tikader & Gajbe, 1975
• Himachal Pradesh (Gajbe, 1988)
• Maharashtra (Meshram, 2011)
• Uttar Pradesh (Tikader & Gajbe, 1975; Tikader, 1982; Hore & Uniyal, 2008a, b, c; Uniyal & Hore, 2009)
Elsewhere: Bhutan.

31. *Drassodes gosiutus* Chamberlin, 1919 ♦
• Manipur (Kananbala *et al.*, 2018)
Elsewhere: Canada, USA.

32. *Drassodes gujaratensis* Patel & Patel, 1975 *

• Gujarat (Patel & Patel, 1975; Siliwal *et al.*, 2003b; Yadav *et al.*, 2017)
• Himachal Pradesh (Gajbe, 1988)
• West Bengal (Dhali *et al.*, 2017)

33. *Drassodes haribhaiius* (Patel & Patel, 1975) *
Syn. *Phaeocedus haribhaiius* Patel & Patel, 1975
• Gujarat (Patel & Patel, 1975; Yadav *et al.*, 2017; Sankaran *et al.*, 2020b)

34. *Drassodes heterophthalmus* Simon, 1905 *
• Maharashtra (Tikader, 1982)
• Tamil Nadu (Simon, 1905)

35. *Drassodes himalayensis* Tikader & Gajbe, 1975
Syn. *Geodrassus himalayensis* Tikader & Gajbe, 1975 - generic name erroneously mentioned by Majumder &Talukdar (2013)
• Arunachal Pradesh (Tikader & Gajbe, 1975; Gajbe, 1988, 2005; Biswas & Biswas, 2006)
• Assam (Gajbe, 2005)
• Chhattisgarh (Gajbe, 1988; Gajbe, 2003a)
• Himachal Pradesh (Gajbe, 1988, 2005)
• Jammu & Kashmir (Gajbe, 1988, 2005)
• Madhya Pradesh (Gajbe, 2003a; Gajbe, 1988, 2005)
• Meghalaya (Tikader, 1982; Gajbe, 1988, 2005)
• Odisha (Gajbe, 1988, 2005)
• Rajasthan (Gajbe, 1988, 2005)
• Uttar Pradesh (Gajbe, 1988)
• Uttarakhand (Tikader & Gajbe, 1975; Tikader, 1982; Gajbe, 1988, 2005)
• West Bengal (Gajbe, 1988, 2005; Majumder & Talukdar, 2013)
Elsewhere: Bhutan

36. *Drassodes involutus* (Pickard-Cambridge, 1885) *
Syn. *Drassus involutus* Pickard-Cambridge, 1885
• Jammu & Kashmir (Pickard-Cambridge, 1885; Caporiacco, 1935)

37. *Drassodes lapidosus* (Walckenaer, 1802)
• Kerala (Sherriffs, 1919)
• Rajasthan (Bhanotar *et al.*, 1980)
Elsewhere: Caucasus, Central Asia, China, Europe, Iran, Israel, Japan, Korea, Russia, Turkey.

38. *Drassodes luridus* (O. Pickard-Cambridge, 1874) *
Syn. *Drassus luridus* O. Pickard-Cambridge, 1874; *Scopodes maitraiae* Tikader & Gajbe, 1977; *Scopoides maitraiae* (Tikader & Gajbe, 1977); *Scopoides samarae* Gawande & Bodkhe, 2018)
• Andhra Pradesh (Majumder, 2005)
• Chhattisgarh (Gajbe, 2003a; Gajbe & Sharma, 1994; Gajbe, 2007; Kujur & Ekka, 2016)
• Gujarat (Gajbe, 1988, 2005, 2007; Thumar, 2019)
• Karnataka (Tabasum *et al.*, 2018)
• Madhya Pradesh (Gajbe, 1988, 2005; Gajbe, 2003a, b; Patil, 2012)
• Maharashtra (Pickard-Cambridge, 1874; Tikader & Gajbe, 1977b; Tikader, 1982; Gajbe, 1988, 2007; Majumder, 2005; Rithe, 2012; Gawande & Bodkhe, 2018; Sankaran *et al.*, 2019)
• Odisha (Gajbe, 1988, 2005, 2007)

- Rajasthan (Sivaperuman & Rathore, 2004; Lawania & Mathur, 2017a, b; Malhotra *et al.*, 2019)
- Tamil Nadu (Sankaran *et al.*, 2019; Caleb & Karthikeyani, 2020; Caleb, 2020a)
- Uttar Pradesh (Hore & Uniyal, 2008a, b; Uniyal & Hore, 2009)
- Uttarakhand (Biswas & Biswas, 2010)

39. *Drassodes macilentus* (O. Pickard-Cambridge, 1874) *
Syn. *Drassus macilentus* O. Pickard-Cambridge, 1874
- Gujarat (Yadav *et al.*, 2017)
- Maharashtra (Pickard-Cambridge, 1874; Tikader, 1982)

40. *Drassodes meghalayaensis* Tikader and Gajbe, 1977 *
- Chhattisgarh (Kujur & Ekka, 2016)
- Madhya Pradesh (Gajbe, 2003a)
- Meghalaya (Tikader & Gajbe, 1977c; Biswas & Majumder, 1995; Gajbe, 2005)
- West Bengal (Gajbe, 2005; Dhali *et al.*, 2017)

41. *Drassodes narayanpurensis* Gajbe, 2005 *
- Chhattisgarh (Gajbe, 2005)
- Maharashtra (Rithe, 2012)

42. *Drassodes parvidens* Caporiacco, 1934
- Andhra Pradesh (Palem *et al.*, 2016)
- Gujarat (Patel & Vyas, 2001; Yadav *et al.*, 2017)
- Himachal Pradesh (Bastawade, 2008)
- Jammu & Kashmir (Caporiacco, 1935; Tikader, 1982; Bastawade, 2008)
- Ladakh (Caporiacco, 1934; Tikader, 1982; Uniyal, 2006)
- Rajasthan (Sivaperuman & Rathore, 2004; Jangid *et al.*, 2019)
- Uttar Pradesh (Hore & Uniyal, 2008a, b; Uniyal & Hore, 2009)

Elsewhere: Pakistan.

43. *Drassodes pashanensis* Tikader & Gajbe, 1977 *
- Chhattisgarh (Gajbe, 2003a; Gajbe, 2005, 2007)
- Madhya Pradesh (Gajbe, 2003a; Gajbe, 1988, 2007)
- Maharashtra (Tikader & Gajbe, 1977c; Tikader, 1982; Rithe, 2012)
- Odisha (Biswas, 1987; Gajbe, 1988, 2005)
- Punjab (Gajbe, 1988, 2005)

44. *Drassodes rubicundulus* Caporiacco, 1934
Syn. *Drassodes (Brachydrassodes) rubicundulus* Caporiacco, 1934
- Jammu & Kashmir (Caporiacco, 1934, 1935; Tikader, 1982)

Elsewhere: Pakistan.

45. *Drassodes sagarensis* Tikader, 1982 *
- Chhattisgarh (Kujur & Ekka, 2012; Ekka & Kujur, 2015)
- Karnataka (Tikader, 1982; Gajbe, 2005)
- Madhya Pradesh (Gajbe, 2003a; Gajbe, 2005, 2007; Patil, 2012)
- Maharashtra (Meshram, 2011; Vairale &Wagh, 2021)

46. *Drassodes singulariformis* Roewer, 1951 *
Syn. *Drassodes singularis* Caporiacco, 1934
- Jammu & Kashmir (Caporiacco, 1934; Tikader, 1982)

47. *Drassodes sirmourensis* (Tikader & Gajbe, 1977)
Syn. *Geodrassus sirmourensis* Tikader & Gajbe, 1977

• Himachal Pradesh (Tikader & Gajbe, 1977c; Tikader, 1982; Bastawade, 2008)
• Meghalaya (Biswas & Majumder, 1995)
• Madhya Pradesh (Gajbe, 2003a; Gajbe, 2005, 2007)
• Punjab (Chandra *et al.*, 2021)
• Uttarakhand (Biswas & Biswas, 2010)
• Gujarat (Yadav *et al.*, 2017)
Elsewhere: China.

48. *Drassodes sitae* Tikader & Gajbe, 1975 *
• Himachal Pradesh (Gajbe, 1988)
• Maharashtra (Rithe, 2012; More & Sawant, 2013)
• Odisha (Majumder, 2005)
• Punjab (Gajbe, 1988)
• Uttar Pradesh (Majumder, 2005)
• Uttarakhand (Tikader & Gajbe, 1975; Tikader, 1982; Gajbe, 1988)

49. *Drassodes tikaderi* (Gajbe, 1987) *
Syn. *Rachodrassus tikaderi* Gajbe, 1987
• Chhattisgarh (Kujur & Ekka, 2012; Ekka & Kujur, 2015)
• Himachal Pradesh (Gajbe, 1987b)
• Maharashtra (Rithe, 2012; More & Sawant, 2013)

50. *Drassodes villosus* (Thorell, 1856) ♦
• Maharashtra (More & Sawant, 2013)
Elsewhere: Central Asia, Europe, Iran, Russia, Turkey.

51. *Drassodes viveki* (Gajbe, 1992) *
Syn. *Haplodrassus viveki* Gajbe, 1992
• Maharashtra (Rithe, 2012; More & Sawant, 2013)
• Uttarakhand (Gajbe, 1992a)

52. *Drassodes* sp.
• Uttar Pradesh (Lawania & Mathur, 2014a, b, c)
• Gujarat (Siliwal *et al.*, 2003a; Solanki, 2016)
• Jammu & Kashmir (Punjoo & Bhat, 2015; Chandra *et al.*, 2021)
• Karnataka (Bhat *et al.*, 2013)
• Kerala (Patel, 2003; Adarsh & Nameer, 2015)
• Maharashtra (Nerlekar *et al.*, 2016)
• Rajasthan (Lawania & Trigunayat, 2015; Jangid *et al.*, 2019)
• Uttarakhand (Uniyal *et al.*, 2011)

53. *Drassyllus* sp.
• Gujarat (Yadav *et al.*, 2017)

54. *Echemus chaperi* Simon, 1885 *
• Karnataka (Simon, 1885)

55. *Echemus interemptor* (O. Pickard-Cambridge, 1885) *
Syn. *Drassus interemptor* (O. Pickard-Cambridge, 1885
• Ladakh (Pickard-Cambridge, 1885)

56. *Echemus viveki* Gajbe, 1989 *
• West Bengal (Gajbe, 1989)

57. *Eilica kandarpae* Nigam & Patel, 1996 *
• Uttar Pradesh (Nigam & Patel, 1996)

58. ***Eilica platnicki*** Tikader & Gajbe, 1977 *
• Maharashtra (Tikader & Gajbe, 1977d; Tikader, 1982)

59. ***Eilica songadhensis*** Patel, 1988 *
• Uttar Pradesh (Patel, 1988a)

60. ***Eilica tikaderi*** Platnick, 1976 *
• Gujarat (Prajapati *et al.*, 2016; Yadav *et al.*, 2017)
• Karnataka (Platnick, 1985)
• Maharashtra (Platnick, 1976a; Platnick & Shadab, 1981; Tikader, 1982)
• Rajasthan (Jangid *et al.*, 2019)
• West Bengal (Platnick, 1985)

61. ***Eilica*** sp.
• Gujarat (Parmar *et al.*, 2015)

62. ***Gnaphosa dege*** Ovtsharenko, Platnick & Song, 1992
• Himachal Pradesh (Marusik *et al.*, 2014)
Elsewhere: China, Kyrgyzstan, Pakistan.

63. ***Gnaphosa jodhpurensis*** Tikader and Gajbe, 1977
• Chhattisgarh (Kujur & Ekka, 2016)
• Gujarat (Gajbe, 1988; Patel & Pillai, 1988)
• Madhya Pradesh (Gajbe, 2003a; Gajbe, 2005, 2007)
• Maharashtra (Meshram, 2011; Rithe, 2012)
• Punjab (Gajbe, 1988)
• Rajasthan (Tikader & Gajbe, 1977a; Tikader, 1982; Gajbe, 1988, 2005; Jangid *et al.*, 2019)
• Uttar Pradesh (Gajbe, 2005)

Elsewhere: China.

64. ***Gnaphosa kailana*** Tikader, 1966 *
• Kerala (Sebastian *et al.*, 2005; Adarsh & Nameer, 2016)
• Maharashtra (More, 2015)
• Punjab (Tikader, 1982)
• Rajasthan (Tikader, 1966, 1982; Jangid *et al.*, 2019)
• Uttar Pradesh (Hore & Uniyal, 2008a, b; Uniyal & Hore, 2009)

65. ***Gnaphosa kankhalae*** Biswas & Roy, 2008 *
• Uttarakhand (Biswas & Roy, 2008)

66. ***Gnaphosa pauriensis*** Tikader & Gajbe, 1977 *
• Bihar (Gajbe, 1988, 2005)
• Chhattisgarh (Gajbe, 2003a; Gajbe, 2005, 2007; Kujur & Ekka, 2012; Ekka & Kujur, 2015)
• Himachal Pradesh (Gajbe, 1988, 2005)
• Madhya Pradesh (Gajbe, 2003a; Gajbe, 2005)
• Maharashtra (Rithe, 2012; Khandelwal, 2014)
• Odisha (Biswas, 1987; Gajbe, 1988, 2005)
• Punjab (Gajbe, 1988, 2005)
• Tamil Nadu (Karthikeyani, 2013)
• Uttar Pradesh (Gajbe, 2005)
• Uttarakhand (Tikader & Gajbe, 1977a; Tikader, 1982; Gajbe, 1988)

67. ***Gnaphosa poonaensis*** Tikader, 1973 *

- Andhra Pradesh (Gajbe, 1988; Gajbe, 2005)
- Chhattisgarh (Kujur & Ekka, 2012; Ekka & Kujur, 2015)
- Gujarat (Gajbe, 1988; Patel & Pillai, 1988; Siliwal *et al.*, 2003a, b; Yadav *et al.*, 2017)
- Himachal Pradesh (Tikader, 1982; Gajbe, 1988
- Madhya Pradesh (Gajbe, 1988, 2007; Gajbe, 2003a, b; Patil, 2012)
- Maharashtra (Tikader, 1973, 1982; Meshram, 2011; Rithe, 2012; More & Sawant, 2013)
- Punjab (Gajbe, 1988)
- Rajasthan (Tikader, 1982; Gajbe, 1988)
- Uttar Pradesh (Tikader, 1982)
- Uttarakhand (Uniyal *et al.*, 2011)
- West Bengal (Majumder & Talukdar, 2013)

68. *Gnaphosa rohtakensis* Gajbe, 1992
- Haryana (Gajbe, 1992b)
- Kerala (Smitha & Sudhikumar, 2020)

69. *Gnaphosa sticta* Kulczyński, 1908 ♦
- Karnataka (Prashanthakumara & Venkateshwarlu, 2017)

Elsewhere: Japan, Russia, Scandinavia.

70. *Gnaphosa stoliczkai* O. Pickard-Cambridge, 1885
- Gujarat (Siliwal *et al.*, 2003a; Parmar *et al.*, 2015; Yadav *et al.*, 2017)
- Jammu & Kashmir (Tikader, 1982)
- Maharashtra (Tikader, 1982)
- Uttar Pradesh (Hore & Uniyal, 2008a, b, c; Uniyal & Hore, 2009)

Elsewhere: China, Mongolia, Pakistan.

71. *Gnaphosa* sp.
- Gujarat (Patel & Vyas, 2001)
- Kerala (Patel, 2003)
- Ladakh (Uniyal, 2006)
- Madhya Pradesh (Gajbe, 2004)
- Maharashtra (Lanka *et al.*, 2017)
- Mizoram (Chowdhury *et al.*, 2017)
- Odisha (Choudhury *et al.*, 2019)
- Rajasthan (Sivaperuman & Rathore, 2004; Jangid *et al.*, 2019)
- Tamil Nadu (Kapoor, 2008)
- Uttar Pradesh (Hore & Uniyal, 2008a, b)
- Uttarakhand (Uniyal *et al.*, 2011)

72. *Haplodrassus ambalaensis* Gajbe, 1992 *
- Punjab (Gajbe, 1992a)
- Uttar Pradesh (Hore & Uniyal, 2008b)

73. *Haplodrassus bengalensis* Gajbe, 1992 *
- Uttar Pradesh (Hore & Uniyal, 2008a)
- West Bengal (Gajbe, 1992a)

74. *Haplodrassus chotanagpurensis* Gajbe, 1987 *
- Jharkhand (Gajbe, 1987c)

75. *Haplodrassus dalmatensis* (L. Koch, 1866) ♦
- Jammu & Kashmir (Punjoo & Bhat, 2015)

Elsewhere: Europe, Middle East, North Africa, Russia, Turkey.

76. *Haplodrassus dumdumensis* Tikader, 1982 *
• Uttarakhand (Biswas & Biswas, 2010)
• West Bengal (Tikader, 1982; Biswas & Biswas, 1992; Majumder, 2005)

77. *Haplodrassus jacobi* Gajbe, 1992 *
• Meghalaya (Gajbe, 1992a)

78. *Haplodrassus morosus* (O. Pickard-Cambridge, 1872) ♦
• Uttar Pradesh (Hore, 2009)
Elsewhere: Greece, Israel, Turkey.

79. *Haplodrassus omissus* (O. Pickard-Cambridge, 1872)
• Jammu & Kashmir (Caporiacco, 1935)
Elsewhere: Canary Is., Central Asia, Morocco, Mediterranean, Pakistan.

80. *Haplodrassus sataraensis* Tikader & Gajbe, 1977 *
• Chhattisgarh (Gajbe, 2003a; Gajbe, 2005, 2007)
• Himachal Pradesh (Gajbe, 1988, 2005)
• Madhya Pradesh (Gajbe, 1988, 2005, 2007; Gajbe, 2003a)
• Maharashtra (Tikader & Gajbe, 1977c; Gajbe, 2005; Rithe, 2012)
• Odisha (Gajbe, 1988, 2005)
• Punjab (Gajbe, 1988, 2005)
• Rajasthan (Gajbe, 1988, 2005)
• Uttar Pradesh (Gajbe, 2005)
• Uttarakhand (Gajbe, 1988; Biswas & Biswas, 2010)

81. *Haplodrassus tehriensis* Tikader & Gajbe, 1977 *
• Uttar Pradesh (Uniyal & Hore, 2009)
• Uttarakhand (Tikader & Gajbe, 1977c; Gajbe, 1988)

82. *Haplodrassus* sp.
• Gujarat (Solanki, 2016; Yadav *et al.*, 2017)
• Ladakh (Uniyal, 2006)
• Uttar Pradesh (Hore & Uniyal, 2008a, b)

83. *Heser vijayanagara* Bosselaers, 2010 *
• Karnataka (Bosselaers, 2010)

84. *Hitobia lamhetaghatensis* (Gajbe & Gajbe, 1999) *
Syn. *Sergiolus lamhetaghatensis* Gajbe & Gajbe, 1999
• Madhya Pradesh (Gajbe & Gajbe, 1999; Gajbe, 2003a, b; Patil, 2012)
• Maharashtra (Rithe, 2012)

85. *Hitobia meghalayensis* (Tikader & Gajbe, 1976) *
Syn. *Sergiolus meghalayensis* Tikader & Gajbe, 1976
• Chhattisgarh (Kujur & Ekka, 2016)
• Meghalaya (Tikader & Gajbe, 1976b; Tikader, 1982; Biswas & Majumder, 1995)

86. *Hitobia poonaensis* (Tikader & Gajbe, 1976) *
Syn. *Sergiolus poonaensis* Tikader & Gajbe, 1976
• Chhattisgarh (Gajbe, 2003a; Kujur & Ekka, 2012; Ekka & Kujur, 2015)
• Madhya Pradesh (Gajbe, 1988, 2005, 2007; Gajbe, 2003a; Patil, 2012)
• Maharashtra (Tikader & Gajbe, 1976b; Tikader, 1982; Gajbe, 1988; Rithe, 2012)

87. *Hitobia procula* Sankaran & Sebastian, 2018 *
• Kerala (Sankaran & Sebastian, 2018)

88. ***Hitobia singhi*** (Tikader & Gajbe, 1976) *
Syn. *Sergiolus singhi* Tikader & Gajbe, 1976
• Chhattisgarh (Kujur & Ekka, 2012; Ekka & Kujur, 2015)
• Karnataka (Tikader & Gajbe, 1976b; Tikader, 1982; Gajbe, 1988)
• Madhya Pradesh (Gajbe, 2003a; Gajbe, 2007; Patil, 2012)
• Maharashtra (Gajbe, 1988, 2005)

89. ***Ladissa inda*** (Simon, 1897) *
Syn. *Aphantaulax indus* Simon, 1897
• Maharashtra (Simon, 1897b)

90. ***Ladissa latecingulata*** Simon, 1907 *
• Adjemera (Pockham) (Simon, 1907)

91. ***Ladissa*** sp.
• Uttar Pradesh (Hore & Uniyal, 2008b)

92. ***Leptodrassus*** sp.
• Tamil Nadu ? (Sherriffs, 1919)

93. ***Marinarozelotes jaxartensis*** (Kroneberg, 1875)
Syn. *Drassodes indraprastha* Tikader & Gajbe, 1975; *Scotophaeus chohanius* Patel & Patel, 1975
• Gujarat (Patel & Patel, 1975; Gajbe, 1988; Patel & Pillai, 1988; Siliwal *et al.*, 2003b; Solanki, 2016; Yadav *et al.*, 2017)
• Kerala (Gajbe, 1988)
• Rajasthan (Tikader, 1982)
• Uttar Pradesh (Tikader & Gajbe, 1975; Tikader, 1982; Gajbe, 1988)
Elsewhere: Azerbaijan, Caucasus, China, Hawaii, Iran, Israel, Japan, Korea, Mexico, North Africa, North America, Russia, Philippines, Russia, South Africa.

94. ***Megamyrmaekion ashae*** Tikader & Gajbe, 1977 *
Syn. *Megamyrmaecion ashae* Tikader & Gajbe, 1977
• Gujarat (Solanki, 2016; Yadav *et al.*, 2017)
• Madhya Pradesh (Gajbe, 1988, 2007; Gajbe, 2003a, b; Patil, 2012)
• Maharashtra (Tikader & Gajbe, 1977b; Tikader, 1982; Gajbe, 1988, 2007; Rithe, 2012)
• Rajasthan (Gajbe, 1988, 2007)

95. ***Megamyrmaekion jodhpurense*** Gajbe, 1993 *
Syn. *Megamyrmaecion jodhpurensis* Gajbe, 1993
• Rajasthan (Gajbe, 1993b)

96. ***Megamyrmaekion kajalae*** Biswas & Biswas, 1992 *
• West Bengal (Biswas & Biswas, 1992; Majumder, 2005)

97. ***Megamyrmaekion pritiae*** (Tikader, 1982) *
Syn. *Scopodes pritiae* Tikader, 1982; *Scopoides pritiae* (Tikader, 1982)
• Gujarat (Thumar, 2019)
• Maharashtra (Tikader, 1982; Sankaran *et al.*, 2019)
• Uttarakhand (Biswas & Biswas, 2010)

98. ***Megamyrmaekion tikaderi*** (Gajbe, 1987)
Syn. *Scopodes tikaderi* Gajbe, 1987; *Scopoides tikaderi* Platnick, 1989)
• Chhattisgarh (Gajbe, 1987d; Kujur & Ekka, 2016; Sankaran *et al.*, 2019)
• Madhya Pradesh (Gajbe, 1987d, 2007; Sankaran *et al.*, 2019)

99. ***Micaria dives*** (Lucas, 1846)
Syn. *Micariolepis dives* (Lucas, 1846)
• Jammu & Kashmir (Caporiacco, 1935)
• Tamil Nadu (Caleb, 2017, 2020a)
Elsewhere: Caucasus, Central Asia, China, Europe, Iran, Israel, Japan, Korea, Russia, Turkey

100. ***Micaria dives concolor*** (Caporiacco, 1935)
• Jammu & Kashmir (Caporiacco, 1935)
Elsewhere: Pakistan.

101. ***Micaria faltana*** Bhattacharya, 1935 *
• West Bengal (Bhattacharya, 1935)

102. ***Micaria pulcherrima*** Caporiacco, 1935
• Himachal Pradesh (Marusik *et al.*, 2014)
• Jammu & Kashmir (Caporiacco, 1935)
Elsewhere: China, Pakistan, Russia.

103. ***Micaria*** sp.
• Gujarat (Parasharya & Pathan, 2013)

104. ***Nodocion*** sp. ♦
• Chhattisgarh (Kujur & Ekka, 2016)

105. ***Nomisia harpax*** (O. Pickard-Cambridge, 1874) *
Syn. *Gnaphosa harpax* O. Pickard-Cambridge, 1874
• Maharashtra (Pickard-Cambridge, 1874; Tikader, 1982; Bastawade & Khandal, 2006)

106. ***Nomisia*** sp.
• Gujarat (Parmar, 2018)

107. ***Poecilochroa barmani*** Tikader, 1982 *
• Andhra Pradesh (Majumder, 2004, 2005)
• Madhya Pradesh (Gajbe, 2007)
• Chhattisgarh (Kujur & Ekka, 2016)
• Gujarat (Thumar, 2019)
• Karnataka (Bhat *et al.*, 2013)
• Kerala (Adarsh & Nameer, 2016)
• Madhya Pradesh (Gajbe, 2003a, b; Gajbe, 2007; Patil, 2012)
• Maharashtra (Rithe, 2012; More & Sawant, 2013)
• Meghalaya (Tikader, 1982; Biswas & Biswas, 1992; Biswas & Majumder, 1995)
• West Bengal (Biswas & Biswas, 1992; Majumder, 2004, 2005)

108. ***Poecilochroa behni*** Thorell, 1891 *
• Andaman & Nicobar Islands (Thorell, 1891)

109. ***Poecilochroa devendrai*** Gajbe & Rane, 1985 *
• West Bengal (Gajbe & Rane, 1985)

110. ***Poecilochroa khodiar*** (Patel, 1988) *
Syn. *Sergiolus khodiarae* Patel, 1988
• Gujarat (Patel, 1988b; Yadav *et al.*, 2017)

111. ***Poecilochroa kuljitae*** (Tikader, 1982) *
Syn. *Scopodes kuljitae* Tikader, 1982; *Scopoides kuljitae* (Tikader, 1982)
• Gujarat (Solanki, 2016; Yadav *et al.*, 2017)

• Karnataka (Tikader, 1982; Biswas & Biswas, 1992; Majumder, 2004, 2005)
• Maharashtra (Tikader, 1982; Biswas & Biswas, 1992; Majumder, 2004, 2005)
• Uttarakhand (Biswas & Biswas, 2010)
• West Bengal (Biswas & Biswas, 1992; Majumder, 2004, 2005)

112. ***Poecilochroa poonaensis*** (Tikader, 1982)
Syn. *Phaeocedus poonaensis* Tikader, 1982; *Poecilochroa taborensis* Levy, 1999
• Gujarat (Patel & Vyas, 2001; Yadav *et al.*, 2017)
• Maharashtra (Tikader, 1982; Sankaran *et al.*, 2020b)
Elsewhere: Cyprus, Greece, Portugal, Israel.

113. ***Poecilochroa sedula*** (Simon, 1897) *
Syn. *Callilepis sedula* Simon, 1897
• Rajasthan (Sivaperuman & Rathore, 2004)
• Uttarakhand (Simon, 1897a; Dalmas, 1921; Tikader, 1982)

114. ***Poecilochroa tikaderi*** Patel, 1989
• Chhattisgarh (Ekka & Kujur, 2015; Kujur & Ekka, 2016)
• Gujarat (Patel, 1989; Parmar *et al.*, 2015; Yadav *et al.*, 2017)

115. ***Poecilochroa tridotus*** Caleb & Mathai, 2013
• Tamil Nadu (Caleb & Mathai, 2013; Karthikeyani *et al.*, 2017; Caleb, 2020a)

116. ***Poecilochroa*** sp.
• Assam (Basumatary & Brahma, 2017)
• Gujarat (Parmar & Patel, 2015)
• Karnataka (Bhat *et al.*, 2013)
• Kerala (Sudhikumar *et al.*, 2005)
• Rajasthan (Sivaperuman & Rathore, 2004)
• Tamil Nadu (Caleb, 2020b)

117. ***Prodidomus chaperi*** (Simon, 1884) *
Syn. *Miltia chaperi S*imon, 1884
• Karnataka (Simon, 1885)
• Tamil Nadu (Simon, 1884)

118. ***Prodidomus palkai*** Cooke, 1972 *
• Andhra Pradesh (Cooke, 1972)

119. ***Prodidomus papavanasanemensis*** Cooke, 1972 *
• Andhra Pradesh (Cooke, 1972)

120. ***Prodidomus saharanpurensis*** (Tikader, 1982) *
Syn. *Micaria saharanpurensis* Tikader, 1982
• Uttar Pradesh (Tikader, 1982)

121. ***Prodidomus sirohi*** Platnick, 1976 *
• Rajasthan (Platnick, 1976b)

122. ***Prodidomus tirumalai*** Cooke, 1972 *
• Andhra Pradesh (Cooke, 1972)

123. ***Prodidomus venkateswarai*** Cooke, 1972 *
• Andhra Pradesh (Cooke, 1972)

124. ***Prodidomus*** sp.

• Gujarat (Solanki, 2016)

125. *Pterotricha strandi* Spassky, 1936
Syn. *Pterotricha tikaderi* Gajbe, 1983)
• Gujarat (Gajbe, 1983)
• Tamil Nadu (Caleb & Karthikeyani, 2020)
Elsewhere: Afghanistan, Iran, Turkmenistan.

126. *Scopoides* sp.
Note: Species of *Scopoides* described/recorded in India have been transferred to either *Drassodes*, *Megamyrmaekion* or *Poecilochroa*, hence it might belong to one of these genera.
• Chhattisgarh (Ekka & Kujur, 2015)
• Gujarat (Siliwal *et al.*, 2003a; Solanki, 2016; Yadav *et al.*, 2017)

127. *Scotophaeus bharatae* Gajbe, 1989 *
• Maharashtra (More & Sawant, 2013)
• West Bengal (Gajbe, 1989)

128. *Scotophaeus blackwalli* (Thorell, 1871)
• Kerala (Sumesh & Sudhikumar, 2020)
• Manipur (Kananbala *et al.*, 2018)
Elsewhere: Caucasus, Europe, Hawaii, Iran, North America, Peru.

129. *Scotophaeus domesticus* Tikader, 1962 *
• West Bengal (Tikader, 1962, 1982; Tikader & Biswas, 1981; Biswas & Biswas, 1992; Majumder, 2005)

130. *Scotophaeus goaensis* (Tikader, 1982) *
Syn. *Herpyllus goaensis* Tikader, 1982
• Chhattisgarh (Gajbe, 2003a; Kujur & Ekka, 2012; Ekka & Kujur, 2015)
• Goa (Tikader, 1982; Bastawade & Borkar, 2008)
• Madhya Pradesh (Gajbe, 2003a, b; Gajbe, 2005, 2007; Patil, 2012)
• Manipur (Kananbala *et al.*, 2018)

131. *Scotophaeus kalimpongensis* Gajbe, 1992 *
• West Bengal (Gajbe, 1992c)

132. *Scotophaeus madalasae* Tikader & Gajbe, 1977 *
• Gujarat (Kumar & Shivakumar, 2006)
• Himachal Pradesh (Gajbe, 1988)
• Uttarakhand (Tikader & Gajbe, 1977b; Tikader, 1982; Gajbe, 1988)
• West Bengal (Gajbe, 1988; Majumder & Talukdar, 2013)

133. *Scotophaeus merkaricola* Strand, 1907 *
• Karnataka (Strand, 1907)
• Kerala (Joseph *et al.*, 2017)

134. *Scotophaeus poonaensis* Tikader, 1982 *
• Gujarat (Patel & Pillai, 1988)
• Madhya Pradesh (Gajbe, 2003a, b; Gajbe, 2005, 2007; Patil, 2012)
• Maharashtra (Tikader, 1982; More & Sawant, 2013)

135. *Scotophaeus rajasthanus* Tikader, 1966 *
• Gujarat (Patel & Pillai, 1988)

• Rajasthan (Tikader, 1966; Tikader, 1982)

136. ***Scotophaeus simlaensis*** Tikader, 1982
• Himachal Pradesh (Tikader, 1982)
Elsewhere: China.

137. ***Scotophaeus*** sp.
• Gujarat (Parasharya & Pathan, 2013)
• Karnataka (Bhat *et al.*, 2013)
• Kerala (Jose *et al.*, 2018)
• Maharashtra (Lanka *et al.*, 2017)
• Uttar Pradesh (Hore & Uniyal, 2008a, b)
• Uttarakhand (Uniyal *et al.*, 2011)

138. ***Sergiolus montanus*** (Emerton, 1890) ♦
• Jammu & Kashmir (Punjoo & Bhat, 2015)
• Maharashtra (Rithe, 2012)
Elsewhere: North America.

139. ***Setaphis browni*** (Tucker, 1923)
Syn. *Liodrassus mandae* Tikader & Gajbe, 1977)
• Himachal Pradesh (Tikader & Gajbe, 1977b; Tikader, 1982; Gajbe, 1988)
• Uttar Pradesh (Gajbe, 1988)
Elsewhere: Central and South Africa, Pakistan.

140. ***Setaphis parvula*** (Lucas, 1846) ♦
• Odisha (Choudhury *et al.*, 2019)
Elsewhere: Mediterranean.

141. ***Setaphis solanensis*** (Tikader & Gajbe, 1977) *
Syn. *Nodocion solanensis* Tikader & Gajbe, 1977
• Himachal Pradesh (Tikader & Gajbe, 1977c; Tikader, 1982; Sankaran *et al.*, 2020a)

142. ***Setaphis subtilis*** (Simon, 1897)
Syn. *Drassodes oppenheimeri* Tikader, 1973; *Drassodes lubrica* (Simin, 1905); *Mulicymnis lubrica* Simon, 1905)
• Chhattisgarh (Gajbe, 2003a)
• Gujarat (Gajbe, 1988, 2005)
• Madhya Pradesh (Tikader, 1982; Gajbe, 1988, 2005, 2007; Biswas & Biswas, 1992; Gajbe, 2003a, b; Patil, 2012)
• Maharashtra (Tikader, 1982; Gajbe, 1988, 2005; Biswas & Biswas, 1992; Meshram, 2011)
• Odisha (Biswas, 1987; Gajbe, 1988, 2005)
• Puducherry (Simon, 1905; Tikader, 1982)
• Uttarakhand (Biswas & Biswas, 2010)
• West Bengal (Tikader, 1973, 1982; Gajbe, 1988, 2005; Biswas & Biswas, 1992)
Elsewhere: Egypt, Middle East to Pakistan, India, Philippines, Thailand, West and South Africa through Ethiopia.

143. ***Setaphis tikaderi*** (Gajbe, 1993) *
Syn. *Nodocion tikaderi* Gajbe, 1993j; *Liodrassus tikaderi* (Gajbe, 1993)
• Chhattisgarh (Kujur & Ekka, 2012; Ekka & Kujur, 2015)
• Madhya Pradesh (Gajbe, 1993c; Gajbe, 2003a, b; Patil, 2012; Sankaran *et al.*, 2020a)

144. ***Setaphis*** sp.

• Jammu & Kashmir (Khan, 2011)

145. ***Sosticus dherikanalensis*** Gajbe, 1979 *
• Madhya Pradesh (Gajbe, 2003a; Gajbe, 2005, 2007; Patil, 2012)
• Odisha (Gajbe, 1979; Tikader, 1982; Biswas, 1987; Choudhury *et al.*, 2019)

146. ***Sosticus jabalpurensis*** Bhandari & Gajbe, 2001 *
• Chhattisgarh (Kujur & Ekka, 2012; Ekka & Kujur, 2015)
• Madhya Pradesh (Bhandari & Gajbe, 2001; Gajbe, 2003a, b; Patil, 2012)
• Maharashtra (Rithe, 2012)

147. ***Sosticus nainitalensis*** Gajbe, 1979 *
• Gujarat (Yadav, 2019)
• Maharashtra (Vairale &Wagh, 2021)
• Uttarakhand (Gajbe, 1979; Tikader, 1982; Biswas & Biswas, 2010)

148. ***Sosticus pawani*** Gajbe, 1993 *
• Himachal Pradesh (Gajbe, 1993d)

149. ***Sosticus poonaensis*** Tikader, 1982 *
• Gujarat (Siliwal *et al.*, 2003b)
• Madhya Pradesh (Gajbe, 2003a; Gajbe, 2005, 2007)
• Maharashtra (Tikader, 1982; Gajbe, 2005; Rithe, 2012; Vairale &Wagh, 2021)

150. ***Sosticus solanensis*** Gajbe, 1979 *
• Himachal Pradesh (Gajbe, 1979; Tikader, 1982)

151. ***Sosticus sundargarhensis*** Gajbe, 1979 *
• Assam (Gajbe, 1979)
• Gujarat (Siliwal *et al.*, 2003a)
• Odisha (Gajbe, 1979; Tikader, 1982; Biswas, 1987)

152. ***Sosticus*** sp.
• Chhattisgarh (Kujur & Ekka, 2016)

153. ***Synaphosus iunctus*** Sankaran & Sebastian, 2018
• Kerala (Sankaran & Sebastian, 2018)

154. ***Synaphosus parvus*** (O. Pickard-Cambridge, 1906)
Syn. *Phaeocedus parvus* Pickard-Cambridge, 1906
• India? (Pickard-Cambridge, 1906)

155. ***Talanites tibialis*** Caporiacco, 1934
• Jammu & Kashmir (Caporiacco, 1934, 1935; Tikader, 1982)
Elsewhere: Pakistan.

156. ***Urozelotes patulusus*** Sankaran & Sebastian, 2018
• Kerala (Sankaran & Sebastian, 2018)

157. ***Urozelotes rusticus*** (L. Koch, 1872)
Syn. *Drassodes malodes* Tikader, 1962
• Uttar Pradesh (Singh & Singh, 2014; Sharma & Singh, 2018)
• West Bengal (Tikader, 1962; Tikader & Biswas, 1981; Biswas & Biswas, 1992; Majumder, 2005)

Elsewhere: Argentina, Australia, Brazil, Britain, Denmark, France, Germany, Hungary, Israel, Italy, Japan, Korea, Libya, Mexico, Netherlands, North Africa, North America, Portugal, South Africa.

158. *Zelotes ashae* Tikader & Gajbe, 1976 *
- Kerala (Adarsh & Nameer, 2016)
- Madhya Pradesh (Gajbe, 2003a; Gajbe, 2005, 2007)
- Maharashtra (Tikader & Gajbe, 1976c; Tikader, 1982; Gajbe, 2005; Rithe, 2012)
- Rajasthan (Tikader & Gajbe, 1976c; Tikader, 1982; Jangid *et al.*, 2019)
- Tamil Nadu (Karthikeyani *et al.*, 2017)

159. *Zelotes baltoroi* Caporiacco, 1934 *
- Jammu & Kashmir (Caporiacco, 1934; Tikader, 1982)

160. *Zelotes bharatae* Gajbe, 2005 *
- Chhattisgarh (Kujur & Ekka, 2016)
- Madhya Pradesh (Gajbe, 2005)
- Maharashtra (Rithe, 2012)

161. *Zelotes calcuttaensis* (Biswas, 1984) *
Syn. *Herpyllus calcuttaensis* Biswas, 1984
- Uttar Pradesh (Hore, 2009)
- West Bengal (Biswas, 1984; Biswas & Biswas, 1992; Majumder, 2005; Sankaran *et al.*, 2021)

162. *Zelotes chandosiensis* Tikader & Gajbe, 1976 *
- Maharashtra (Meshram, 2011; Khandelwal, 2014)
- Uttar Pradesh (Tikader & Gajbe, 1976c; Tikader, 1982)

163. *Zelotes choubeyi* Tikader & Gajbe, 1979 *
- Maharashtra (Tikader & Gajbe, 1979; Tikader, 1982; Meshram, 2011)

164. *Zelotes desioi* Caporiacco, 1934 *
- Jammu & Kashmir (Caporiacco, 1934, 1935; Tikader, 1982)
- Rajasthan (Sivaperuman & Rathore, 2004)

165. *Zelotes hospitus* (Simon, 1897) *
- Maharashtra (Simon, 1897b)

166. *Zelotes jabalpurensis* Tikader & Gajbe, 1976 *
- Chhattisgarh (Kujur & Ekka, 2012; Ekka & Kujur, 2015)
- Madhya Pradesh (Tikader & Gajbe, 1976c; Gajbe, 2003a, b; Gajbe, 2007; Patil, 2012)
- Maharashtra (Rithe, 2012)

167. *Zelotes kusumae* Tikader, 1982 *
- Maharashtra (Tikader, 1982; Meshram, 2011; Rithe, 2012)

168. *Zelotes maindroni* (Simon, 1905) *
Syn. *Scotophinus maindroni* Simon, 1905
- Gujarat (Patel & Pillai, 1988)
- Tamil Nadu (Simon, 1905; Tikader, 1982; Karthikeyani *et al.*, 2017)

169. *Zelotes mandae* Tikader & Gajbe, 1979 *
- Gujarat (Solanki, 2016; Yadav *et al.*, 2017)
- Madhya Pradesh (Gajbe, 2003a; Gajbe, 2005, 2007)

• Maharashtra (Tikader & Gajbe, 1979; Tikader, 1982; Meshram, 2011)

170. *Zelotes mandlaensis* Tikader & Gajbe, 1976 *
• Arunachal Pradesh (Biswas & Biswas, 2006)
• Gujarat (Yadav *et al.*, 2017)
• Madhya Pradesh (Tikader & Gajbe, 1976c; Tikader, 1982; Gajbe, 1988, 2007; Gajbe, 2003a)
• Punjab (Gajbe, 1988)
• Uttarakhand (Biswas & Biswas, 2010)

171. *Zelotes nainitalensis* Tikader & Gajbe, 1976 *
• Gujarat (Yadav, 2019)
• Haryana (Malik & Goyal, 2017)
• Uttar Pradesh (Uniyal & Hore, 2009)
• Uttarakhand (Tikader & Gajbe, 1976c; Tikader, 1982; Biswas & Biswas, 2010)

172. *Zelotes naliniae* Tikader & Gajbe, 1979 *
• Maharashtra (Tikader & Gajbe, 1979; Tikader, 1982; Rithe, 2012; More & Sawant, 2013; More, 2015)

173. *Zelotes nasikensis* Tikader & Gajbe, 1976 *
• Madhya Pradesh (Gajbe, 2003a; Gajbe, 2007)
• Maharashtra (Tikader & Gajbe, 1976c; Tikader, 1982; Rithe, 2012; More & Sawant, 2013; More, 2015)
• Rajasthan (Sivaperuman & Rathore, 2004)

174. *Zelotes nilgirinus* Reimoser, 1934 *
• Tamil Nadu (Reimoser, 1934; Karthikeyani *et al.*, 2017)

175. *Zelotes pexus* (Simon, 1885) *
Syn. *Prosthesima pexa* Simon, 1885
• Karnataka (Simon, 1885)
• Uttar Pradesh (Hore, 2009)

176. *Zelotes poonaensis* Tikader & Gajbe, 1976 *
• Chhattisgarh (Kujur & Ekka, 2016)
• Maharashtra (Tikader & Gajbe, 1976c; Tikader, 1982; Gajbe, 1988; Meshram, 2011; Rithe, 2012; More & Sawant, 2013)
• Rajasthan (Gajbe, 1988)

177. *Zelotes pseudopusillus* Caporiacco, 1934 *
• Jammu & Kashmir (Caporiacco, 1934, 1935; Tikader, 1982)
• West Bengal (Raychaudhuri *et al.*, 2016; Saha *et al.*, 2016)

178. *Zelotes sajali* Tikader & Gajbe, 1979 *
• Gujarat (Gajbe, 1988; Kumar & Shivakumar, 2004)
• Maharashtra (Tikader & Gajbe, 1979; Tikader, 1982; Gajbe, 1988)

179. *Zelotes sataraensis* Tikader & Gajbe, 1979 *
• Andhra Pradesh (Gajbe, 1988, 2005)
• Chhattisgarh (Gajbe, 2003a; Gajbe, 2005)
• Himachal Pradesh (Gajbe, 1988, 2005)
• Karnataka (Gajbe, 1988, 2005)
• Madhya Pradesh (Gajbe, 1988, 2005; Gajbe, 2003a)
• Maharashtra (Tikader & Gajbe, 1979; Gajbe, 1988, 2005; Rithe, 2012)
• Odisha (Choudhury *et al.*, 2019)

• Rajasthan (Gajbe, 1988, 2005)
• Uttar Pradesh (Gajbe, 1988, 2005)
• Uttarakhand (Gajbe, 1988)

180. *Zelotes scrutatus* (O. Pickard-Cambridge, 1872)
Syn. *Herpyllus bicolor* (Simon, 1885)
• Andhra Pradesh (Tikader, 1982)
Elsewhere: Africa, Canary Is. to Central Asia.

181. *Zelotes shantae* Tikader, 1982 *
• Chhattisgarh (Gajbe & Sharma, 1994)
• Gujarat (Patel & Pillai, 1988)
• Madhya Pradesh (Gajbe, 2003a; Gajbe, 2007)
• Maharashtra (Tikader, 1982; Keswani & Vankhede, 2014)
• Rajasthan (Lawania & Mathur, 2017a)

182. *Zelotes sindi* Caporiacco, 1934
• Jammu & Kashmir (Caporiacco, 1935; Tikader, 1982)
Elsewhere: Pakistan.

183. *Zelotes surekhae* Tikader & Gajbe, 1976 *
• Maharashtra (Tikader & Gajbe, 1976c; Tikader, 1982; Meshram, 2011)
• Uttarakhand (Biswas & Biswas, 2010)

184. *Zelotes tambaramensis* Caleb & Mathai, 2013 *
• Tamil Nadu (Caleb & Mathai, 2013; Karthikeyani *et al.*, 2017; Caleb, 2020a)

185. *Zelotes univittatus* (Simon, 1897) *
• Maharashtra (Simon, 1897b)

186. *Zelotes viveki* Gajbe, 2005 *
• Chhattisgarh (Gajbe, 2005)
• Maharashtra (Rithe, 2012)

187. *Zelotes yogeshi* Gajbe, 2005 *
• Chhattisgarh (Gajbe, 2005; Kujur & Ekka, 2012; Ekka & Kujur, 2015)
• Maharashtra (Rithe, 2012)

188. *Zelotes* sp.
• Chhattisgarh (Ekka & Kujur, 2015)
• Goa (Pandit & Pai, 2017)
• Gujarat (Siliwal *et al.*, 2003b; Parmar *et al.*, 2015; Yadav *et al.*, 2017)
• Jammu & Kashmir (Khan, 2011; Punjoo & Bhat, 2015)
• Karnataka (Abhijith, 2019)
• Maharashtra (Lanka *et al.*, 2017)
• Manipur (Kananbala *et al.*, 2018)
• Odisha (Choudhury *et al.*, 2019)
• Uttar Pradesh (Hore & Uniyal, 2008a, b, c)
• Uttarakhand (Uniyal *et al.*, 2011)

189. *Zimiris diffusa* Platnick & Penney, 2004
• Kerala (Platnick & Penney, 2004)
Elsewhere: St. Helena, Yemen (Socotra).

190. *Zimiris doriae* Simon, 1882
Syn. *Zimiris doriai* Simon, 1882; *Zimiris indica* Simon, 1884

• Gujarat (Thumar, 2019)
• Tamil Nadu (Simon, 1884, 1885; Dalmas, 1919; Sherriffs, 1919)
Elsewhere: Brazil, Caribbean, Eritrea, French Guiana, Germany, Indonesia, Iran, Ivory Coast, Malaysia, Mexico, Sudan, Yemen.

191. ***Zimiris*** sp.
• Kerala (Sunil Jose *et al.*, 2008)

II. List of species designated nomina dubia

1. ***Melicymnis bicolor*** Simon, 1885
• Karnataka (Simon, 1885)

2. ***Melicymnis*** sp.
• Gujarat (Yadav *et al.*, 2017)

III. Checklist of Gnaphosidae in Indian States

1. Andhra Pradesh: *Drassodes luridus*, *Drassodes parvidens, Gnaphosa poonaensis, Poecilochroa barmani, Prodidomus palkai*, *Prodidomus papavanasanemensis*, *Prodidomus tirumalai*, *Prodidomus venkateswarai*, *Zelotes sataraensis, Zelotes scrutatus*.

2. **Arunachal Pradesh:** *Drassodes himalayensis, Zelotes mandlaensis*.

3. Assam: *Drassodes himalayensis, Poecilochroa* sp., *Sosticus sundargarhensis*.

4. Bihar: *Gnaphosa pauriensis*.

5. Chhattisgarh: *Callilepis chakanensis*, *Callilepis ketani*, *Callilepis lambai*, *Callilepis rukminiae*, *Cryptodrassus khajuriai, Drassodes himalayensis, Drassodes luridus*, *Drassodes meghalayaensis*, *Drassodes narayanpurensis, Drassodes pashanensis, Drassodes sagarensis, Drassodes tikaderi, Gnaphosa jodhpurensis*, *Gnaphosa pauriensis, Gnaphosa poonaensis, Haplodrassus sataraensis, Hitobia meghalayensis*, *Hitobia poonaensis, Hitobia singhi*, *Megamyrmaekion tikaderi*, *Nodocion* sp., *Poecilochroa barmani, Poecilochroa tikaderi, Scopoides* sp., *Scotophaeus goaensis*, *Setaphis subtilis*, *Setaphis tikaderi*, *Sosticus jabalpurensis, Zelotes bharatae, Zelotes jabalpurensis, Zelotes poonaensis, Zelotes sataraensis, Zelotes shantae, Zelotes viveki, Zelotes yogeshi*.

6. Goa: *Scotophaeus goaensis*, *Zelotes* sp.

7. Gujarat: *Callilepis* sp., *Camillina* sp., *Cryptodrassus mahabalei*, *Drassodes cerinus*, *Drassodes gujaratensis, Drassodes haribhaiius*, *Drassodes luridus*, *Drassodes macilentus, Drassodes parvidens, Drassodes sirmourensis*, *Drassyllus* sp., *Eilica tikaderi, Gnaphosa jodhpurensis*, *Gnaphosa poonaensis*, *Gnaphosa stoliczkai*, *Haplodrassus* sp., *Marinarozelotes jaxartensis*, *Megamyrmaekion ashae, Megamyrmaekion pritiae, Micaria* sp., *Nomisia* sp., *Poecilochroa barmani, Poecilochroa khodiar*, *Poecilochroa kuljitae, Poecilochroa poonaensis*, *Poecilochroa tikaderi, Prodidomus* sp., *Pterotricha strandi, Scopoides* sp., *Scotophaeus madalasae, Scotophaeus poonaensis, Scotophaeus rajasthanus, Setaphis subtilis*, *Sosticus nainitalensis, Sosticus poonaensis, Sosticus sundargarhensis, Zelotes maindroni, Zelotes mandae, Zelotes mandlaensis, Zelotes nainitalensis, Zelotes sajali, Zelotes shantae,Zimiris doriae*.

8. Haryana: *Gnaphosa rohtakensis, Zelotes nainitalensis*.

9. Himachal Pradesh: *Drassodes deoprayagensis, Drassodes gangeticus*, *Drassodes gujaratensis, Drassodes himalayensis, Drassodes parvidens, Drassodes sirmourensis*, *Drassodes sitae, Drassodes tikaderi, Gnaphosa dege*, *Gnaphosa pauriensis, Gnaphosa poonaensis, Haplodrassus sataraensis, Micaria pulcherrima, Scotophaeus madalasae, Scotophaeus simlaensis*, *Setaphis browni*, *Setaphis solanensis, Sosticus pawani*, *Sosticus solanensis*, *Zelotes sataraensis*.

10. Jharkhand: *Callilepis pawani*, *Haplodrassus chotanagpurensis*.

11. Karnataka: *Aphantaulax trifasciata*, *Berlandina* sp., *Callilepis ketani*, *Callilepis lambai*, *Drassodes luridus*, *Drassodes sagarensis, Echemus chaperi*, *Eilica tikaderi, Gnaphosa sticta*, *Heser vijayanagara*, *Hitobia singhi*, *Poecilochroa barmani, Poecilochroa kuljitae, Prodidomus chaperi, Scotophaeus merkaricola, Zelotes pexus, Zelotes sataraensis*.

12. Kerala: *Drassodes carinivulvus*, *Drassodes delicatus, Drassodes lapidosus, Gnaphosa kailana, Gnaphosa rohtakensis, Hitobia procula*, *Marinarozelotes jaxartensis*, *Poecilochroa barmani, Scotophaeus blackwalli*, *Scotophaeus merkaricola, Synaphosus iunctus*, *Urozelotes patulusus*, *Zelotes ashae, Zimiris diffusa*.

13. Madhya Pradesh: *Callilepis chakanensis*, *Callilepis ketani*, *Callilepis lambai, Callilepis rukminiae*, *Cryptodrassus khajuriai, Cryptodrassus mahabalei*, *Drassodes himalayensis, Drassodes luridus*, *Drassodes meghalayaensis*, *Drassodes pashanensis, Drassodes sagarensis, Drassodes sirmourensis*, *Gnaphosa jodhpurensis*, *Gnaphosa pauriensis, Gnaphosa poonaensis, Haplodrassus sataraensis, Hitobia lamhetaghatensis, Hitobia poonaensis, Hitobia singhi*, *Megamyrmaekion ashae, Megamyrmaekion tikaderi, Poecilochroa barmani, Poecilochroa barmani, Scotophaeus goaensis*, *Scotophaeus poonaensis, Setaphis subtilis*, *Setaphis tikaderi*, *Sosticus dherikanalensis, Sosticus jabalpurensis, Sosticus poonaensis, Zelotes ashae, Zelotes bharatae, Zelotes jabalpurensis, Zelotes mandae, Zelotes mandlaensis, Zelotes nasikensis, Zelotes sataraensis, Zelotes shantae*.

14. Maharashtra: *Callilepis chakanensis*, *Callilepis ketani*, *Callilepis lambai*, *Callilepis pawani*, *Callilepis rajani*, *Callilepis rukminiae*, *Cryptodrassus mahabalei*, *Cryptodrassus platnicki*, *Cryptodrassus ratnagiriensis*, *Drassodes astrologus, Drassodes cambridgei*, *Drassodes deoprayagensis, Drassodes gangeticus*, *Drassodes heterophthalmus, Drassodes luridus*, *Drassodes macilentus, Drassodes narayanpurensis, Drassodes pashanensis, Drassodes sagarensis, Drassodes sitae, Drassodes tikaderi, Drassodes villosus*, *Drassodes viveki, Eilica platnicki*, *Eilica tikaderi, Gnaphosa jodhpurensis*, *Gnaphosa kailana, Gnaphosa pauriensis, Gnaphosa poonaensis, Gnaphosa stoliczkai*, *Haplodrassus sataraensis, Hitobia lamhetaghatensis*, *Hitobia poonaensis, Hitobia singhi*, *Ladissa inda*, *Megamyrmaekion ashae, Megamyrmaekion pritiae, Nomisia harpax*, *Poecilochroa barmani, Poecilochroa kuljitae, Poecilochroa poonaensis*, *Scotophaeus bharatae, Scotophaeus poonaensis, Sergiolus montanus*, *Setaphis subtilis*, *Sosticus jabalpurensis, Sosticus nainitalensis, Sosticus poonaensis, Zelotes ashae, Zelotes bharatae, Zelotes chandosiensis, Zelotes choubeyi*, *Zelotes hospitus*, *Zelotes jabalpurensis, Zelotes kusumae*, *Zelotes mandae, Zelotes naliniae*, *Zelotes nasikensis, Zelotes poonaensis, Zelotes sajali, Zelotes sataraensis, Zelotes shantae, Zelotes surekhae, Zelotes univittatus*, *Zelotes viveki,Zelotes yogeshi*.

15. Manipur: *Drassodes gosiutus*, *Scotophaeus blackwalli*, *Scotophaeus goaensis*, *Zelotes* sp.

16. Meghalaya: *Drassodes himalayensis, Drassodes meghalayaensis*, *Drassodes sirmourensis*, *Haplodrassus jacobi*, *Hitobia meghalayensis*, *Poecilochroa barmani*.

17. Mizoram: *Gnaphosa* sp.

18. Odisha: *Drassodes astrologus, Drassodes himalayensis, Drassodes luridus*, *Drassodes pashanensis, Drassodes sitae, Gnaphosa pauriensis, Haplodrassus sataraensis, Setaphis parvula*, *Setaphis subtilis*, *Sosticus dherikanalensis, Sosticus sundargarhensis, Zelotes sataraensis*.

19. Punjab: *Callilepis ketani*, *Callilepis lambai*, *Drassodes pashanensis, Drassodes sirmourensis*, *Drassodes sitae, Gnaphosa jodhpurensis*, *Gnaphosa kailana, Gnaphosa pauriensis, Gnaphosa poonaensis, Haplodrassus ambalaensis, Haplodrassus sataraensis, Zelotes mandlaensis*.

20. Rajasthan: *Gnaphosa poonaensis, Callilepis ketani*, *Callilepis lambai*, *Callilepis rajasthanica, Callilepis rukminiae*, *Drassodes himalayensis, Drassodes lapidosus, Drassodes luridus*, *Drassodes parvidens, Eilica tikaderi, Gnaphosa jodhpurensis*, *Gnaphosa kailana, Haplodrassus sataraensis, Marinarozelotes jaxartensis*, *Megamyrmaekion ashae, Megamyrmaekion jodhpurense*, *Poecilochroa sedula, Prodidomus sirohi*, *Scotophaeus rajasthanus, Zelotes ashae, Zelotes desioi, Zelotes nasikensis, Zelotes poonaensis, Zelotes sataraensis, Zelotes shantae*.

21. Tamil Nadu: *Berlandina plumalis*, *Callilepis rukminiae*, *Drassodes heterophthalmus, Drassodes luridus*, *Gnaphosa pauriensis, Leptodrassus* sp., *Micaria dives, Poecilochroa tridotus, Prodidomus chaperi, Pterotricha strandi, Zelotes ashae, Zelotes maindroni, Zelotes nilgirinus*, *Zelotes tambaramensis*, *Zimiris doriae*.

22. Tripura: *Coillina yogeshi*.

23. Uttar Pradesh: *Callilepis ketani*, *Callilepis lambai*, *Callilepis rukminiae*, *Drassodes delicatus, Drassodes gangeticus*, *Drassodes himalayensis, Drassodes luridus*, *Drassodes parvidens, Drassodes sitae, Eilica kandarpae*, *Eilica songadhensis*, *Gnaphosa jodhpurensis*, *Gnaphosa kailana, Gnaphosa pauriensis, Gnaphosa poonaensis, Gnaphosa stoliczkai*, *Haplodrassus ambalaensis, Haplodrassus bengalensis, Haplodrassus morosus*, *Haplodrassus sataraensis, Haplodrassus tehriensis, Ladissa* sp., *Marinarozelotes jaxartensis*, *Prodidomus saharanpurensis*, *Scotophaeus* sp., *Setaphis browni*, *Urozelotes rusticus*, *Zelotes calcuttaensis*, *Zelotes chandosiensis, Zelotes nainitalensis, Zelotes pexus, Zelotes sataraensis*.

24. Uttarakhand: *Callilepis rajani*, *Camillina smythiesi*, *Drassodes deoprayagensis, Drassodes himalayensis, Drassodes luridus*, *Drassodes sirmourensis*, *Drassodes sitae, Drassodes viveki, Gnaphosa kankhalae*, *Gnaphosa pauriensis, Gnaphosa poonaensis, Haplodrassus dumdumensis, Haplodrassus sataraensis, Haplodrassus tehriensis, Megamyrmaekion pritiae, Poecilochroa kuljitae, Poecilochroa sedula, Scotophaeus madalasae, Setaphis subtilis*, *Sosticus nainitalensis, Zelotes mandlaensis, Zelotes nainitalensis, Zelotes sataraensis, Zelotes surekhae*.

25. West Bengal: *Drassodes gujaratensis, Drassodes himalayensis, Drassodes meghalayaensis*, *Echemus viveki*, *Eilica tikaderi, Gnaphosa poonaensis, Haplodrassus bengalensis, Haplodrassus dumdumensis, Megamyrmaekion kajalae*, *Micaria faltana, Poecilochroa barmani, Poecilochroa devendrai*, *Poecilochroa kuljitae, Scotophaeus bharatae, Scotophaeus domesticus*, *Scotophaeus kalimpongensis*, *Scotophaeus madalasae, Setaphis subtilis*, *Urozelotes rusticus*, *Zelotes calcuttaensis*, *Zelotes pseudopusillus*.

IV. Checklist of Gnaphosidae in Union Territories

1. Andaman & Nicobar Islands: *Drassodes andamanensis*, *Poecilochroa behni*.

2. Jammu & Kashmir: *Berlandina drassodea*, *Berlandina plumalis*, *Callilepis lambai*, *Callilepis rukminiae*, *Drassodes carinivulvus*, *Drassodes clavifemur*, *Drassodes dispulsus*, *Drassodes himalayensis, Drassodes involutus*, *Drassodes parvidens, Drassodes rubicundulus*, *Drassodes singulariformis*, *Gnaphosa stoliczkai*, *Haplodrassus dalmatensis*, *Haplodrassus omissus*, *Micaria dives, Micaria dives concolor*, *Micaria pulcherrima, Sergiolus montanus*, *Setaphis* sp., *Talanites tibialis*, *Zelotes baltoroi*, *Zelotes desioi, Zelotes pseudopusillus, Zelotes sindi*.

3. Ladakh: *Coreodrassus interlisus*, *Drassodes dispulsus*, *Drassodes parvidens, Echemus interemptor*, *Gnaphosa* sp., *Haplodrassus* sp.

4. Puducherry: *Setaphis subtilis*.

V. Checklist of Gnaphosidae of doubtful occurrence in India

1. ***Ladissa latecingulata*** Simon, 1907
• Adjemera (Peckham) (Simon, 1907)

A single source of location of Adjemera is mentioned in Ghana (west coast of Africa) by Estrella & Devesa (2014) in available literature and also the title of the article of Simon (1907) describing the species indicates that it was collected from the west coast of Africa indicating its location in Ghana and not in India. Moreover, Siliwal *et al.* (2005), Keswani *et al.* (2012), Caleb & Sankaran (2021) and World Spider Catalog (2021) consider its location in India. Murphy (2007) seems to have examined the type and provided the registration number and the location as India without mentioning its exact location. Perhaps the original label of the type (MNHN, Paris) could be helpful in finding the locality in detail.

2. ***Synaphosus parvus*** (O. Pickard-Cambridge, 1906)

Pickard-Cambridge (1906) stated that he received the material by Newbery, N.E. who observed the spider in a package of damaged British goods, sent out to India and returned thence. He also argued that it might be indigenous British species. Keswani *et al.* (2012) and Caleb & Sankaran (2021) listed the species in Indian checklists; however, World Spider Catalog (2021) questioned its distribution in India (?).

Acknowledgment

We thank Dr. J.T.D. Caleb, Zoological Survey of India, Kolkata, India for providing valuable literature and suggestions.

References

Abhijith, A.P.C. 2019. https://www.mysorenature.org/mysorenature/Spiders-of-Mysore-Area, as on 15/10/2019.

Adarsh, C.K. & Nameer, P.O. 2015. Spiders of Kerala Agricultural University Campus, Thrissur, Kerala, India. *Journal of Threatened Taxa*, 7(15): 8288-8295.

Adarsh, C.K. & Nameer, P.O. 2016. A preliminary checklist of spiders (Araneae: Arachnida) in Chinnar Wildlife Sanctuary, Western Ghats, India. *Journal of Threatened Taxa*, 8(4): 8703-8713.

Azevedo, G.H.F., Griswold, C.E. & Santos, A.J. 2018. Systematics and evolution of ground spiders revisited (Araneae, Dionycha, Gnaphosidae). *Cladistics*, 34(6): 579-626.

Bastawade, D.B. 2008. Arachnida: Araneae. In: *Fauna of Pin Valley National Park, Conservation Area Series. Zoological Survey of India, Kolkata*, 34: 37-44.

Bastawade, D.B. & Borkar, M. 2008. Arachnida (orders Scorpiones, Uropygi, Amblypygi, Araneae and Phalangida). In: *Fauna of Goa, State Fauna Series*, *Zoological Survey of India, Kolkata*, 16: 211-242.

Bastawade, D.B. & Khandal, D. 2006. *Araneae*. Conservation Area Series 26: Invertebrate Fauna of Sanjay Gandhi National Park, Borivali, Mumbai, Zoological Survey of India, Kolkata, pp. 139-184.

Basumatary, P. & Brahma, D. 2017. Checklist of spiders from Chakrashila Wildlife Sanctuary, Assam, India. *International Journal of Zoology Studies*, 2(5): 22-26.

Bhandari, R. & Gajbe, P. 2001. Description of four new species of spiders of the families Uloboridae, Philodromidae, Gnaphosidae and Lycosidae (Arachnida: Araneae) from Madhya Pradesh, India. *Records of the Zoological Survey of India*, 99: 87-93.

Bhanotar, R.K., Matho, Y. & Bhatnagar, R.K. 1980. The spider *Drassodes lapidosus* (Walck.) preying upon termites *Microtermes mycophagus* (Desneux) in the Barmer area (Rajasthan). *The Entomologist's Monthly Magazine,* 115(1380/1383): 124.

Bhat, P.S., Srikumar, K.K., Raviprasad, T.N. 2013. Seasonal diversity and status of spiders (Arachnida: Araneae) in cashew ecosystem. *World Applied Sciences Journal,* 22(6): 763-770.

Bhattacharya, G.C. 1935. A new species of gregarious spider mimicking *Camponotus compressus*. *Science & Culture*, 1: 159-160.

Biswas, B. 1984. Description of six new species of spiders of the families Clubionidae, Gnaphosidae and Salticidae from India. *Bulletin of the Zoological Survey of India*, 6: 119-127.

Biswas, B. 1987. *Araneae-Spiders (Families: Araneidae, Gnaphosidae and Salticidae)*, pp. 257-272. In: Zoological Survey of India (eds.), Fauna of Orissa, State Fauna Series, P.I. Zoological Survey of India, Kolkata, 340 pp.

Biswas, B. & Biswas, K. 1992. Araneae: Spiders. In: *Fauna of West Bengal-3*, *State Fauna Series 3. Zoological Survey of India, Kolkata*, pp. 357-500.

Biswas, B. & Biswas, K. 2006. Araneae: Spiders. In: *Fauna of Arunachal Pradesh, State Fauna Series. Zoological Survey of India, Kolkata*, 13(2): 491-518.

Biswas, B. & Biswas, K. 2010. Araneae: Spider. Fauna of Uttarakhand-3. In: *State Fauna Series-18* (Ed.), *Zoological Survey of India*, pp. 243-282.

Biswas, B. & Majumder, S.C. 1995. Araneae: Spider. In. *Fauna of Meghalaya, State Fauna Serie, Zoological Survey of India*, 4(2): 93-128.

Biswas, B. & Roy, R. 2008. Description of six new species of spiders of the genera *Lathys* (Family: Dictynidae), *Marpissa* (Family: Salticidae), *Misumenoides* (Family: Thomisidae), *Agroeca* (Family: Clubionidae), *Gnaphosa* (Family: Gnaphosidae) and *Flanona* (Family: Lycosidae) from India. *Records of the Zoological Survey of India*, 108: 43-57.

Blackwall, J. 1867. Descriptions of several species of East Indian spiders, apparently to be new or little known to arachnologists. *Annals and Magazine of Natural History*, (3)19: 387-394.

Bosselaers, J. 2010. A new species of *Heser* Tuneva, 2005 (Araneae, Gnaphosidae) from the south of India. *ZooKeys*, 73: 1-11.

Caleb, J.T.D. 2017. First record of *Micaria dives* (Lucas, 1846) (Araneae: Gnaphosidae) from India. *Indian Journal of Arachnology*, 6: 51-54.

Caleb, J.T.D. 2020a. Spiders (Arachnida: Araneae) from the vicinity of Araabath Lake, Chennai, India. *Journal of Threatened Taxa*, 12(1): 15186-15193.

Caleb, J.T.D. 2020b. Spider (Arachnida: Araneae) fauna of the scrub jungle in the Madras Christian College campus, Chennai, India. *Journal of Threatened Taxa*, 12(7): 15711-15766.

Caleb, J.T.D. & Karthikeyani, R. 2020. JoTT Checklist of the spiders of Tamil Nadu (v1.0), 10 February 2020.

Caleb, J.T.D. & Mathai, M.T. 2013. New species of *Poecilochroa* Westring and *Zelotes* Gistel (Araneae: Gnaphosidae) from Tamil Nadu, India. *Indian Journal of Arachnology*, 2(2): 1-6.

Caleb, J.T.D. & Sankaran, P.M. 2021. Araneae of India, version 2021. https://indianspiders.in. Retrieved on 5 May, 2021.

Caporiacco, L.di 1934. Aracnidi dell'Himalaia e del Karakoram raccolti dalla Missione Italiana al Karakoram (1929-VII). *Memorie della Società Entomologica Italiana, Genova*, 13: 113-160.

Caporiacco, L.di 1935. Aracnidi dell'Himalaia e del Karakoram, raccolti dalla Missione italiana al Karakoram 1929-VII). *Memorie della Società Entomologica Italiana, Genova*, 13: 161-263.

Chandra, K., Bharti, D., Kumar, S., Raghunathan, C., Gupta, D., Alfred, J.R.B. & Chowdhury, B.R. 2021. *Faunal Diversity in Ramsar Wetlands of India*. Zoological Survey of India, Kolkata, pp. 1-292.

Choudhury, S.R., Siliwal, M. & Das, S.K. 2019. Spiders of Odisha: a preliminary checklist. *Journal of Threatened Taxa*, 11(9): 14144-14157.

Chowdhury, S., Boopathi Bhattacharjee, T.B., Dey, J.K. & Bhattacharjee, J. 2017. Diversity of predatory spider and their species composition in rice ecosystem in Kolasib district of Mizoram. *Innovative Farming*, 2(1): 12-18.

Cooke, J.A.L. 1972. Four new species of *Prodidomus* (Araneae: Prodidomidae) from south India. *Journal of the New York Entomological Society*, 80: 129-136.

Dalmas, R.de 1919. Synopsis des araignées de la famille des Prodidomidae. *Annales de la Société Entomologique de France*, 87: 279-340.

Dalmas, R.de 1921. Monographie des araignées de la section des *Pterotricha* (Aran. Gnaphosidae). *Annales de la Société Entomologique de France*, 89: 233-328.

Dhali, D.C., Saha, S. & Raychaudhuri, D. 2017. Litter and ground dwelling spiders (Araneae: Arachnida) of reserve forests of Dooars, West Bengal (Monograph). *World Scientific News*, 63: 1-242.

Ekka, A. & Kujur, R. 2015. Spider diversity of Ram Jharna, Raigarh district, Chhattisgarh, India. *Research Journal of Pharmacy & Technology*, 8(7): 813-819.

Estrella, M. & Devesa, J.A. 2014. The Genus *Gilbertiodendron* (Leguminosae-Caesalpinioideae) in Western Africa. *Systematic Botany*, 39(1): 160-192.

Gajbe, P. 2003a. A checklist of spiders (Arachnida: Araneae) of Jabalpur, Madhya Pradesh, India. *Records of Zoological Survey of India, Kolkata*, 101(3-4): 43-47.

Gajbe, P. 2003b. Checklist of spiders (Arachnida: Araneae) of Madhya Pradesh and Chhattisgarh. *Zoos' Print Journal*, 18(10): 1223-1226.

Gajbe, P. 2004. Description of three new species of crab spiders (Araneae: Thomisidae) from Madhya Pradesh, India. *Records of the Zoological Survey of India*, 103(1-2): 123-130.

Gajbe, U.A. 1979. Studies on some spiders of the genus *Sosticus* from India (Araneae: Gnaphosidae). *Bulletin of the Zoological Survey of India*, 2: 69-74.

Gajbe, U.A. 1983. A new *Pterotricha* spider from India (Araneae: Gnaphosidae). *Bulletin of the Zoological Survey of India*, 5: 95-97.

Gajbe, U.A. 1984. On three new species of spiders of the genus *Callilepis* Westring (Family: Gnaphosidae) from India. *Records of the Zoological Survey of India*, 81: 127-133.

Gajbe, U.A. 1987a. A new *Drassyllus* spider from India (Araneae: Gnaphosidae). *Bulletin of the Zoological Survey of India*, 8: 289-290.

Gajbe, U.A. 1987b. A new *Rachodrassus* spider from India (Araneae: Gnaphosidae). *Bulletin of the Zoological Survey of India*, 8: 281-283.

Gajbe, U.A. 1987c. A new *Haplodrassus* spider from India (Araneae: Gnaphosidae). *Bulletin of the Zoological Survey of India*, 8: 277-279.

Gajbe, U.A. 1987d. A new *Scopodes* spider from India (Araneae: Gnaphosidae). *Bulletin of the Zoological Survey of India*, 8: 285-287.

Gajbe, U.A. 1988. On a collection of spiders of the family Gnaphosidae from India (Araneae: Arachnida). *Records of Zoological Survey of India,* 85(1): 59-74.

Gajbe, U.A. 1989. On two new species of the genera *Scotophaeus* Simon and *Echemus* Simon from India (Araneae: Gnaphosidae). *Records of the Zoological Survey of India*, 84: 557-562.

Gajbe, U.A. 1992a. On two new species of *Haplodrassus* spiders from India (Araneae: Gnaphosidae). *Records of the Zoological Survey of India*, 91: 313-317.

Gajbe, U.A. 1992b. Taxonomic studies on some spiders of the genera *Gnaphosa* Latreille, *Haplodrassus* Chamberlin and *Scotophaeus* Simon (family: Gnaphosidae) from India. *Records of the Zoological Survey of India*, 91: 303-311.

Gajbe, U.A. 1992c. Taxonomic studies on some spiders of the genera *Gnaphosa* Latreille, *Haplodrassus* Chamberlin and *Scotophaeus* Simon (family: Gnaphosidae) from India. *Records of the Zoological Survey of India*, 91: 303-311.

Gajbe, U.A. 1993a. A new *Apodrassodes* spider from India (Araneae: Gnaphosidae). *Records of the Zoological Survey of India*, 91: 227-229.

Gajbe, U.A. 1993b. A new *Megamyrmecion* spider from India (Araneae: Gnaphosidae). *Records of the Zoological Survey of India*, 91: 231-233.

Gajbe, U.A. 1993c. A new *Liodrassus* spider from India (Araneae: Gnaphosidae). *Records of the Zoological Survey of India*, 91: 247-250.

Gajbe, U.A. 1993d. A new *Sosticus* spider from India (Araneae: Gnaphosidae). *Records of the Zoological Survey of India*, 91: 181-183.

Gajbe, U.A. 2005. Studies on some spiders of the family Gnaphosidae (Araneae: Arachnida) from Madhya Pradesh, India. *Records of the Zoological Survey of India*, 105(3-4): 111-140.

Gajbe, U.A. 2007. Araneae: Arachnida.In: Fauna of Madhya Pradesh (including Chhattisgarh), State Fauna Series. Zoological Survey of India, Kolkata, 15(1): 419-540.

Gajbe, U.A. & Gajbe, P. 1999. New species of spider of the genus *Sergiolus* Simon from Madhya Pradesh (family: Gnaphosidae). *Records of the Zoological Survey of India*, 97(4): 99-101.

Gajbe, U.A. & Rane, P.D. 1985. A new species of spider of the genus *Poecilochroa* Westring (Family: Gnaphosidae) from India. *Bulletin of the Zoological Survey of India*, 7(1): 117-119.

Gajbe, U.A. & Sharma, H.S. 1994. On some spiders (Araneae: Arachnida) from Bastar district (Madhya Pradesh) India. *Records of the Zoological Survey of India,* 94(2-4): 233-245.

Gawande, B. & Bodkhe, A. 2018. Description of spider genus *Scopoides* as a new species (Araneae: Gnaphosidae) from Wari Reserve Forest Area, Maharashtra, India. In: Rao, P.N., Saxena, A., Pandey, B.N. & Kulkarni, G.K. (eds.) *Biodiversity and bioprospects: Indian scenario and perspectives*. Today & Tomorrow's Printers and Publishers, New Delhi, pp. 223-228.

Hore, U. 2009. Diversity and structure of spider assemblages in Terai Conservation area, Ph.D. thesis, Saurashtra University, Rajkot, Gujarat. http://etheses.saurashtrauniversity.edu/id/eprint/589.

Hore, U. & Uniyal, V.P. 2008a. Effect of prescribed fire on spider assemblage in Terai grasslands, India. *Turkish Journal of Arachnology*, 1(1): 15-36.

Hore, U. & Uniyal, V.P. 2008b. Diversity and composition of spider assemblages in five vegetation types of the Terai Conservation Area, India. *The Journal of Arachnology*, 36(2): 251-258.

Hore, U. & Uniyal, V.P. 2008c. Use of spiders (Araneae) as indicator for monitoring of habitat conditions in Tarai Conservation Area, India. *Indian Forester*, 134: 1371-1380.

Jangid, A.K., Dewasi, S.R., Kumar, L., Yadav, D., Sharma, V. & Upadhyay, M. 2019. Diversity of spiders (Arachnida: Araneae) from central Aravalli Range, Rajasthan, India. *Serket*, 17(1): 61-67.

Jose, A.C., Sudhin, P.P., Prasad, P.M. & Sreejith, K.A. 2018. Spider diversity in Kavvayi river basin, Kerala, Southern India. *Current World Environment*, 13(1): 100-112.

Joseph, M.M., Paul, J., Sankaran, P.M. & Sebastian, P.A. 2017. Preliminary results on the spider fauna (Arachnida: Araneae) of the high altitude shola ecosystem in the Western Ghats. *Proceedings of the National Conference on Ecology Sustainable Development and Wildlife Conservation*, pp. 41-49.

Kananbala, A., Bhubaneshwari, M. & Siliwal, M. 2018. A checklist of spiders (Arachnidae: Araneae) of Manipur, India with some first records and a new species *Conothele khunthokhanbi* (Family: Ctenizidae). *Journal of Entomology and Zoology Studies*, 6(5): 2209-2214.

Kapoor, V. 2008. Effects of rainforest fragmentation and shade-coffee plantations on spider communities in the Western Ghats, India. *Journal of Insect Conservation,* 12: 53-68.

Karthikeyani, R. 2013. Biodiversity of spiders (Araneae) in Kumbakarai Falls, Periyakulam Taluk, Theni District, Tamil Nadu, South India. Ph.D. thesis, Madurai Kamaraj University, Madurai, 288 pp.

Karthikeyani, R., Caleb, J.T.D., Gajbe, U.A. & Muthuchelian, K. 2017. Checklist of spiders (Arachnida: Araneae) of the State of Tamil Nadu, India. *Munis Entomology & Zoology*, 12(1): 180-193.

Keswani S. & Vankhede G. 2014. Diversity, population and habitat used by spiders in bananaagro-ecosystem. *Indian Journal of Arachnology*, 3(1): 12-27.

Keswani, S., Hadole, P. & Rajoria, A. 2012. Checklist of spiders (Arachnida: Araneae) from India. *Indian Journal of Arachnology*, 1(1): 1-129.

Khan A.A. 2009. Biodiversity of spider fauna (Arachnida: Araneae) in horticultural ecosystem of Kashmir. *Indian Journal of Ecology*, 36(1): 59-64.

Khan, A.A. 2011. Spider fauna on temperate rice in Kashmir. *Oryza*, 48(2):147-153.

Khandelwal, P. 2014. Diversity of spiders fauna from Sarangpuri lake, Arvi, Vidarbha region. *International Journal of Life Sciences*, 2(2):165-167.

Kujur, R. & Ekka, A. 2012. Inventorization of Spider fauna of Indra Vihar Park, Raigarh, Chhattisgarh, India. *IOSR Journal of Environmental Science, Toxicology and Food Technology*, 1(2): 20-26.

Kujur, R. & Ekka, A. 2016. Exploring the spider fauna of Gomarda Wildlife Sanctuary, Chhattisgarh, India. *International Research Journal of Biological Sciences*, 5(6): 31-36.

Kumar, D. & Shivakumar, M.S. 2004. Ecological studies on spiders in rice agroecosystem of Vadodara (Gujarat) with special emphasis on biocontrol aspect. *Indian Journal of Entomology*, 66(4): 323-327.

Kumar, D. & Shivakumar, M.S. 2006. Seasonal abundance of spiders in pigeonpea agroecosystem. *Indian Journal of Environmental Sciences,* 10(1): 43-46.

Lanka, L.P., Kamble, S.S. & Bodkhe, A.K. 2017. An Addition to spider fauna from the vicinity of Radhanagari Wildlife Sanctuary of Kolhapur district. *International Journal of Scientific Engineering and Research*, 5(7): 280-283.

Lawania, K.K. & Mathur, P. 2014a. Baseline studies on the spider fauna (Araneae) of Braj region (Braj-Bhoomi), India. *International Journal of Basic and Applies Biology*, 2(1): 137-141.

Lawania, K.K. & Mathur, P. 2014b. Diversity and distribution of spider fauna in and around the Taj Mahal and Taj Protected Forest, Agra (U.P.), India. *International Journal of Basic and Applied Biology*, 2(2): 111-114.

Lawania, K.K. & Mathur, P. 2014c. On the diversity of spiders in and around Sur-Sarovar Bird Sanctuary, Agra (U.P.), India. *International Journal of Basic and Applied Biology*, 2(3): 189-194.

Lawania, K.K. & Mathur, P. 2017a. Biodiversity and habit preference of spider fauna in eastern region of Rajasthan and its catchment area. *International Journal of Scienticifc Development and research*, 2(6): 475-484.

Lawania, K.K. & Mathur, P. 2017b. Seasonal abundance and population indices of spider fauna in summer seasons of the years 2013 to 2016 from different habitats of eastern region of Rajasthan, India. *International Journal for Research Trends and Innovation*, 2(2): 420-427.

Lawania, K.K. & Trigunayat, M.M. 2015. A comparative study of the spider (Araneae) fauna in Keoladeo National Park (KNP), Nahargarh Wildlife Sanctuary (NWS) and Sur-sarovar Bird Sanctuary (SBS), India. *International Journal on Agricultural Sciences*, 6 (1): 141-146.

Majumder, S.C. 2004. Taxonomic studies of some spiders from mangrove and semi-mangrove areas of Sundarban. *Memoirs of the Zoological Survey of India*, 20(2): 1-42.

Majumder, S.C. 2005. Studies on some spiders from eastern coastal region of India. *Memoirs of the Zoological Survey of India*, 20(3): 1-57.

Majumder, S.C. & Talukdar, S. 2013. Studies on Taxonomy and diversity of spiders from Darjeeling Hills with special reference to family Clubioneidae in light of conservation. *Records of the Zoological Survey of India, Kolkata, Occasional Paper No. 340*, 96 pp.

Malhotra, G.S., Neera, K. & Saxena, M.M. 2019. Spider diversity and abundance in different habitats of Upper-Northern Rajasthan. *ESSENCE International Journal for Environmental Rehabilitation and Conservation*, 10(1): 1-14.

Malik, V. & Goyal, V. 2017. Biodiversity of spiders in different habitats of Western Haryana, India. *Journal of Entomology and Zoology Studies*, 5(4): 822-825.

Marusik, Y.M. & Omelko, M.M. 2019. Redescription of gnaphosids (Aranei: Gnaphosidae) described by O. Pickard-Cambridge from the material of the Second Yarkand Mission. *Arthropoda Selecta*, 28(2): 277-290.

Marusik, Y.M., Ballarin, F., Omelko, M.M. & Koponen, S. 2014. On new and interesting records of spiders from northern Pakistan and India (Aranei). *Arthropoda Selecta*, 23(4): 415-424.

Meshram, A. 2011. Spiders (Arachnida: Araneae) from Toranmal Sanctuary, Maharashtra, India. *E-International Scientific Research Journal*, 3(4): 326-334.

More, S.B. 2015. Spider diversity from Vakoba, Devrai region of Radhanagari Wildlife Sanctuary. *International Journal of Science and Research*, 4(6): 179-181.

More, S. & Sawant, V. 2013. Spider Fauna of Radhanagari Wildlife Sanctuary, Chandoli National Park and Koyna Wildlife Sanctuary. *Indian Journal of Arachnology*, 2(1): 81-92.

Murphy, J. 2007. *Gnaphosid genera of the world*. British Arachnological Society, St Neots, Cambridgeshire 1, i-xii, 1-92; 2, i-ii, 93-605.

Nerlekar, A.N., Warudkar, A.M., Gowande, G.G., Salve, S.S., Raut, A., Patankar, S.R. & Nalavade, S.B. 2016. A review of the faunal diversity of the Fergusson College campus, Pune, India. *Zoos' Print*, 31(10): 4-25.

Nigam, S. & Patel, S.K. 1996. A new species of spider of the genus *Eilica* (Gnaphosidae), a predator from Uttar Pradesh, India. *Geobios New Reports*, 15: 2-4.

Nyffeler, M. & Birkhofer, K. 2017. An estimated 400-800 million tons of prey are annually killed by the global spider community. *The Science of Nature*, 104: 30, 12 pp.

Palem, H., Kanike, S. & Purushottam, V.R.S. 2016. Diversity of spider fauna (Arachnida: Araneae) in different ecosystems, Eastern Ghats, Southern Andhra Pradesh, India. *South Asian Journal of Life Sciences*, 4(2): 51-60.

Pandit, R. & Pai, I. 2017. Spiders of Taleigao Plateau, Goa, India. *Journal of Environmental Science and Public Health*, 1(4): 240-252.

Parasharya, B.M. & Pathan, V.A. 2013. Diversity of spider fauna in Lucerne (*Medicago sativa* L.). *Journal of Biological Control*, 27(4): 253-259.

Parmar, B.M. 2018. Preliminary study of spiders (Order: Araneae) from Satlasana taluka. *International Journal of Pharmacy and Biological Sciences*, 8(3): 735-740.

Parmar, B.M. & Patel, K.B. 2015. Preliminary study of spiders (Order: Araneae) from Taranga Hills. *International Journal of Science and Research*, 6(11): 23-25.

Parmar, B.M., Patel, K.B., Joshi, J.D. & Chaudhari, N.R. 2015. Faunastic study of spiders diversity from islands and coastal areas of Gulf of Kutch, India. *Life Sciences Leaflets*, 67: 12-23.

Patel, B.H. 2003. Fauna of Protected Areas - A Preliminary list of Spiders with the descriptions of three new species from Parambikulum Wildlife sanctuary, Kerala. *Zoos' Print Journal*, 18(10): 1207-1212.

Patel, B.H. & Patel, H.K. 1975. On some new species of spiders of family Gnaphosidae (Araneae: Arachnida) from Gujarat, India. *Records of the Zoological Survey of India*, 68: 33-39.

Patel, B.H. & Pillai, G.K. 1988. Studies on the spider fauna of groundnut fields in Gujarat, India. *Journal of Biological Control*, 2(2): 83-88.

Patel, B.H. & Vyas, R. 2001. Spider of Hingolgadh Nature Education Sanctuary, Gujarat, India. *Zoos' Print Journal*, 16(9): 589-590.

Patel, S.K. 1988a. A new spider species of the genus *Eilica* (Gnaphosidae) from India. *Biological Bulletin of India*, 10: 41-43.

Patel, S.K. 1988b. A new species of spider of the genus *Sergiolus* (Gnaphosidae) from India. *Biological Bulletin of India*, 10: 44-46.

Patel, S.K. 1989. A new species of the spider, genus *Poecilochroa* (Gnaphosidae) from India. *Current Science*, 58: 328-329.

Patil, S.R. 2012. Spiders of Jabalpur District (Arachnida: Araneae): Updated Checklist 2011. *Indian Journal of Arachnology*, 1(1): 143-149.

Picard-Cambridge, O. 1874. On some new species of *Drassides*. *Proceedings of the Zoological Society of London*, 42(1): 370-419.

Picard-Cambridge, O. 1885. Araneidea. In: Scientific results of the second Yarkand mission; based upon the collections and notes of the late Ferdinand Stoliczka, Ph. D. Government of India, Calcutta, 115 pp.

Pickard-Cambridge, O. 1906. On new and rare British Arachnida. *Proceedings of the Dorset Natural History and Antiquarian Field Club*, 26(for 1905): 40-74.

Platnick, N.I. 1976a. A new *Eilica* from India (Araneae, Gnaphosidae). *Bulletin of the British Arachnological Society*, 3(7): 189-190.

Platnick, N.I. 1976b. On Asian *Prodidomus* (Araneae, Gnaphosidae). *Acta Arachnologica*, 27: 37-42.

Platnick, N.I. 1985. Notes on the spider genus *Eilica* (Araneae: Gnaphosidae). *Journal of New York Entomological Society*, 93(3): 1073-1081.

Platnick, N.I. & Penney, D. 2004. A revision of the widespread spider genus *Zimiris* (Araneae, Prodidomidae). *American Museum Novitates*, 3450: 1-12.

Platnick, N.I. & Shadab, M.U. 1981. On the spider genus *Eilica* (Araneae, Gnaphosidae). *Bulletin of the American Museum of Natural History*, 170: 183-188.

Prajapati, D.A., Patel, K.R., Munjpara, S.B., Chettiar, S.S. & Jhala, D.D. 2016. Spiders (Arachnida: Araneae) of Gujarat University Campus, Ahmedabad, India with additional description of *Eilica tikaderi* (Platnick, 1976). *Journal of Threatened Taxa*, 8(11): 9327-9333.

Prashanthakumara S.M. & Venkateshwarlu, M. 2017. Preliminary study of spiders (Araneae: Arachnida) in Gudavi Bird Sanctuary, Shivamogga, Karnataka. *International Journal of Recent Scientific Research*, 8(8): 19277-19281.

Punjoo, S. & Bhat, G.A. 2015. First report of spiders (Arachnida: Araneae) from Dachigam National Park, Kashmir, India. *International Journal of Research*, 2(2): 707-719.

Raychaudhuri, D., Saha, S. & Roy, T.K. 2016. Spiders: a proficient candidate in practising IPM for Darjeeling tea. *World Scientific News*, 38: 1-62.

Reimoser, E. 1934. Araneae aus Süd-Indien. *Revue Suisse de Zoologie*, 41: 465-511.

Reimoser, E. 1935. *Araneida. In: Wissenschaftliche Ergebnisse der niederländischen Expeditionen in den Karakorum*. Zoologie (Leipzig), 1935, 169-176.

Rithe, K. 2012. Spider diversity from relocated area of Melghat Tiger Reserve. *Indian Journal of Arachnology*, 1(2): 92-105.

Roewer, C.F. 1951. Neue Namen einiger Araneen-Arten. *Abhandlungen des Naturwissenschaftlichen Vereins zu Bremen*, 32: 437-456.

Saha, S., Roy, T.K. & Raychaudhuri, D. 2016. Survey on spider faunal diversity of darjeeling tea plantations. *Munis Entomology and Zoology*, 11(2): 622-635.

Sankaran, P.M. & Sebastian, P.A. 2018. New species of gnaphosid spiders (Araneae: Gnaphosidae) from the Western Ghats of India. *Journal of Natural History*, 52(27-28): 1733-1744.

Sankaran, P.M., Caleb, J.T.D. & Sebastian, P.A. 2019. On the taxonomic validity of Indian ground spiders: I. *Scopoides* Platnick, 1989 (Araneae: Gnaphosidae). *Zootaxa*, 4648(1): 155-164.

Sankaran, P.M., Caleb, J.T.D. & Sebastian, P.A. 2020a. On the taxonomic validity of Indian ground spiders: II. Genera *Drassyllus* Chamberlin, 1922 and *Nodocion* Chamberlin, 1922 (Araneae: Gnaphosidae). *European Journal of Taxonomy*, 673: 1-14.

Sankaran, P.M., Caleb, J.T.D. & Sebastian, P. A. 2020b. On the taxonomic validity of Indian ground spiders: III. Genus *Phaeocedus* Simon, 1893 (Araneae: Gnaphosidae). *Journal of Natural History*, 54(21-22): 1325-1336.

Sankaran, P.M., Caleb, J.T.D. & Sebastian, P.A. 2021. On the taxonomic validity of Indian ground spiders: IV. Genera *Apodrassodes* Vellard, 1924, *Herpyllus* Hentz, 1832 and *Sergiolus* Simon, 1892 (Araneae: Gnaphosidae). *Journal of Natural History*, 54(43-44): 2839-2857.

Sebastian, P.A., Mathew, M.J., Beevi, S.P., Joseph, J. & Biju, C.R. 2005. The spider fauna of the irrigated rice ecosystem in central Kerala, India across different elevational ranges. *The Journal of Arachnology,* 33(2): 247-255.

Sharma, A. & Singh, R. 2018. Species diversity and guild structure of spiders from Siddharthnagar, Uttar Pradesh, India. *Research Journal of Life Sciences, Bioinformatics, Pharmaceuticals & Chemical Sciences*, 4(4): 383-390.

Sharma, A., Singh, G. & Singh, R. 2020a. Faunal diversity of Linyphiidae (Araneomorphae: Araneae: Arachnida) in India. *Asian Journal of Conservation Biology*, 9(2): 304-314.

Sharma, A., Singh, R. & Singh, G. 2020b. Faunal diversity of Liocranidae, Mimetidae, Miturgidae, Nesticidae and Oecobiidae (Arachnida: Araneae) of India. *Serket*, 17(3): 270-283.

Sharma, A., Singh, G. & Singh, R. 2021. Faunal diversity of spider families Dictynidae, Dysderidae, Eresidae and Filistatidae (Araneomorphae: Araneae: Arachnida) in India. *International Journal of Zoology and Applied Biosciences,* 6(1): 1-9.

Sherriffs, W.R. 1919. A contribution to the study of south Indian arachnology. *Annals and Magazine of Natural History*, (9)4: 220-253.

Siliwal, M., Suresh, B., Dhuru, S. & Pilo, B. 2003a. Spider diversity of riparian zone of river Vishwamitri, Gujarat. *Journal of Current Science* 3(2): 429-434.

Siliwal, M., Suresh, B. & Pilo, B. 2003b. Fauna of protected areas-3. Spiders of Purna Wildlife Sanctuary, Dangs, Gujarat. *Zoos' Print Journal*, 18(11): 1259-1263.

Siliwal, M., Molur, S. & Biswas, B.K. 2005. Indian spiders (Arachnida, Araneae): updated checklist 2005. *Zoos, Print Journal*, 20(10): 1999-2049.

Simon, E. 1884. Descriptions de quelques arachnides des genres Miltia E. S. et Zimiris E. S. *Annales de la Société Entomologique de Belgique*, 28(C.R.): 139-142.

Simon, E. 1885. Matériaux pour servir à la faune arachnologiques de l'Asie méridionale.I.Arachnides recueillis à Wagra-Karoor près Gundacul, district de Bellary par M.M.Chaper. II. Arachnides recueillis à Ramnad, district de Madura par M.l'abbé Fabre. *Bulletin de la Société Zoologique de France*, 10: 1-39.

Simon, E. 1897a. Matériaux pour servir à la faune arachnologique de l'Asie méridionale.V.Arachnides recueillis à Dehra-Dun (N.W.Prov.) et dans le Dekkan par M.A.Smythies. *Mémoires de la Société Zoologique de France*, 10: 252-262.

Simon, E. 1897b. Arachides recueillis par M.M.Maindron à Kurrachee et à Matheran (près Bombay) en 1896. *Bulletin du Muséum d'Histoire Naturelle*, 3: 289-297.

Simon, E. 1905. Arachnides (1re partie). In: Voyage de M.Maurice Maindron dans l'Inde méridionale.7e Mémoire. *Annales de la Société Entomologique de France*, 74: 160-180.

Simon, E. 1907. Arachnides recueillis par L. Fea sur la côte occidentale d'Afrique.1re partie. *Annali del Museo Civico di Storia Naturale di Genova*, (3)3: 218-323.

Singh, B.B. & Singh, R. 2014. Incidence and biodiversity of riceland spiders (Arthropoda: Arachnida) in northeastern Uttar Pradesh, India. *Indo-American Journal of Life Sciences & Biotechnology*, 2(1): 64-89.

Singh, B.B., Singh, R. & Singh, G. 2020. Faunal diversity of Clubionidae, Ctenidae, Cybaeidae, Deinopidae and Desidae (Araneomorphae: Araneae: Arachnida) in India. *Journal of Applied Bioscience, Lucknow*, 46(1, 2): 32-43.

Singh, B.B., Singh, R. & Singh, G. 2021. Faunal diversity of spitting spiders (Scytodidae: Araneomorphae: Araneae: Arachnida) in India. *World Journal of Pharmaceutical & Life Sciences*, 7(3): 82-89.

Singh, R. 2021a. Distribution of Sparassidae (Araneomorphae: Araneae: Arachnida) in India. *World Journal of Pharmaceutical & Life Sciences*, 7(3): 134-148.

Singh, R. 2021b. Faunal biodiversity of Tetragnathidae (Araneomorphae: Araneae: Arachnida) in India. *International Journal of Biological Innovations*, 3(1): 92-119.

Singh, R. 2021c. Faunal biodiversity of Lycosidae (Araneomorphae: Araneae: Arachnida) in India: an updated checklist. *International Journal of Zoological Investigations*, 7(1): 110-158.

Singh, R. 2021d. Faunal diversity of Theridiidae (Araneomorphae, Araneae, Arachnida) in India, An updated checklist. *International Journal of Biological & Environmental Investugations*, 1(1): 1-30.

Singh, R. 2021e. Faunal diversity of Oxyopidae (Araneomorphae: Araneae: Arachnida) in India: an updated checklist. *Journal of Global Biosciences*, 10(4): 8539-8573.

Singh, R. & Singh, G. 2020. Diversity of mygalomorph spiders (Aranae: Opisthothelae) in India. *International Journal of Biological Innovations*, 2(2): 178-201.

Singh, G. & Singh, R. 2021a. Faunal distribution of spiders of the families Titanoecidae, Trachelidae, Trochanteriidae, Uloboridae and Zodariidae (Arachnida: Araneae) in India. *Serket*, 17(4): 370-393.

Singh, R. & Singh, G. 2021b. Updated checklist of Philodromidae (Araneae: Arachnida) from India. *World Journal of Pharmaceuticals & Life Sciences*, 7(2): 129-139.

Singh, R., Singh, G. & Sharma, A. 2020a. Diversity of yellow sac spiders (Cheiracanthiidae: Araneae: Arachnida) in India. *Journal of Entomology and Zoology Studies*, 8(6): 118-126.

Singh, R., Singh, G. & Sharma, A. 2020b. Faunal diversity of Hahniidae, Hersiliidae and Homalonychidae (Arachnida: Araneae: Araneomorphae) in India. *Serket*, 17(3): 240-251.

Singh, R., Singh, G. & Singh, B.B. 2020c. Diversity of Asemoneinae, Eupoinae, Hisponinae, Lyssomaninae, Onomastinae and Spartaeinae (Arachnida: Araneae: Salticidae) in India: a checklist and bibliography. *Research Journal of Life Sciences, Bioinformatics, Pharmaceuticals & Chemical Science*, 6(5): 29-46.

Singh, R., Singh, G. & Singh, B.B. 2020d. Diversity of Amycoida and Astioida (Arachnida: Araneae: Salticidae: Salticinae) in India. *Journal of Entomology and Zoology Studies*, 8(5): 1478-1488.

Singh, R., Singh, G. & Singh, B.B. 2020e. Diversity of Marpissoida, Chrysillini and Hasariini (Arachnida: Araneae: Salticidae: Salticinae) in India. *Research Journal of Life Sciences, Bioinformatics, Pharmaceuticals & Chemical Science*, 6(6): 15-42.

Singh, R., Singh, G. & Singh, B.B. 2020f. Diversity of simonid spiders (Araneae: Salticidae: Salticinae) in India. *International Journal of Biological Innovations*, 2(2): 247-276.

Singh, R., Singh, G. & Singh, B.B. 2021a. Faunal diversity of jumping spiders (Salticidae: Araneae: Arachnida) in India. *International Journal of Biological Innovations*, 3(1):1-37.

Singh, R., Singh, G. & Singh, B.B. 2021b. Faunal diversity of Agelenidae, Amaurobiidae, Anyphaenidae, Arkyidae, Cithaeronidae and Corinnidae (Araneae: Arachnida) in India. *Munis Entomology & Zoology,* 16(2): 772-786.

Sivaperuman, C. & Rathore, N.S. 2004. A preliminary report on spiders in Desert National Park, Rajasthan, India. *Zoos' Print Journal*, 19(5): 1485-1486.

Smitha, M.S. & Sudhikumar, A.V. 2020. A diversity of spiders (Arachnida: Araneae) from a cashew ecosystem in Kerala, India. *Journal of Threatened Taxa*, 12(13): 16879-16884.

Solanki, R. 2016. Ecology and diversity of spider fauna in southern tropical dry deciduous forests of Gujarat. Ph.D. thesis, The M.S.University of Baroda, Vadodara Gujarat, India, 305 pp.

Strand, E. 1907. Süd- und ostasiatische Spinnen. *Abhandlungen der Naturforschenden Gesellschaft Görlitz,* 25: 107-215.

Sudhikumar, A.V., Mathew, M.J., Sunish, E., Murugesan, S. & Sebastian, P.A. 2005. Preliminary studies on the spider fauna in Mannavan shola forest, Kerala, India (Araneae). *European Arachnol.- Acta Zoologica Bulgarica*, Suppl. No. 1: 319-327.

Sumesh, N.V. & Sudhikumar, A.V. 2020. Checklist of spiders from the sacred groves of northern Kerala, India. *Uttar Pradesh Journal of Zoology*, 41(9): 104-115.

Sunil Jose, K., Sudhikumar, A.V., Davis, S. & Sebastian, P.A. 2008. Preliminary studies on the spider fauna (Arachnida: Araneae) in Parambikulam Wildlife Sanctuary in Western Ghats, Kerala, India. *Journal of the Bombay Natural History Society*, 105(3): 264-273.

Tabasum N.R., Nagaraj B, Shantakumari, S., Sreenivasa, V. & Sai Sandeep, Y. 2018. Assessment of spider diversity and composition along the Tungabhadra Irrigation Channel at Ballari, Karnataka. *International Journal on Biological Sciences*, 9(1): 36-44.

Thorell, T. 1891. Spindlar från Nikobarerna och andra delar af södra Asien. *Kongliga Svenska Vetenskaps-Akademiens Handlingar*, 24(2): 1-149.

Thumar R.H. 2019. *Biodiversity and taxonomic study of predacious spiders of some orchard plants in and around Navsari district*. Gujarat. Ph.D. thesis, Veer Narmad South Gujarat University, Surat, Gujarat, 261 pp.

Tikader, B.K. 1962. On two new species of spiders of the genera *Scotophaeus* and *Drassodes* (family Gnaphosidae) from West Bengal. *Proceedings of the First All-India Congress of Zoology, 1959*, 1: 570-573.

Tikader, B.K. 1966. On a collection of spiders (Araneae) from the desert areas of Rajasthan (India). *Records of the Indian Museum, Calcutta*, 59: 435-443.

Tikader, B.K. 1973. Studies on some spiders of the family Gnaphosidae, from India. *Proceedings of the Indian Academy of Science*, 77(B): 186-189.

Tikader, B.K. 1977. Studies on spider fauna of Andaman and Nicobar islands, Indian Ocean. *Records of the Zoological Survey of India*, 72: 153-212.

Tikader, B.K. 1982. The Fauna of India, Spiders: Araneae, Part 1 Family Araneidae (= Argiopidae) Typical Orb-Weavers, pp.1-293; Part 2 Family Gnaphosidae, *Zoological Survey of India*, Kolkata, pp. 295-536.

Tikader, B.K. & Biswas, B. 1981. Spider fauna of Calcutta and vicinity: Part-I. *Records of the Zoological Survey of India, Occasional Paper*, 30: 1-149.

Tikader, B.K. & Gajbe, U.A. 1975. New species of *Drassodes* spiders (Araneae: Gnaphosidae) from India. *Oriental Insects*, 9: 273-281.

Tikader, B.K. & Gajbe, U.A. 1976a. New spiders of *Drassyllus* from India (Gnaphosidae). *Oriental Insects*, 10: 431-434.

Tikader, B.K. & Gajbe, U.A. 1976b. On some new species of spiders of the genus *Sergiolus* Simon from India (family: Gnaphosidae). *Proceedings of the Indian Academy of Science*, 84(B): 185-191.

Tikader, B.K. & Gajbe, U.A. 1976c. Studies on some spiders of the genus *Zelotes* Gistel from India (family: Gnaphosidae). *Proceedings of the Indian Academy of Science*, 83(B): 109-122.

Tikader, B.K. & Gajbe, U.A. 1977a. Studies on some spiders of the genera *Gnaphosa* Latreille and *Callilepis* Westring (family: Gnaphosidae) from India. *Records of the Zoological Survey of India*, 73: 43-52.

Tikader, B.K. & Gajbe, U.A. 1977b. Studies on some spiders of the genera *Scopodes* Chamberlin, *Megamyrmecion* Reuss, *Scotophaeus* Simon and *Liodrassus* Chamberlin (family: Gnaphosidae) from India. *Records of the Zoological Survey of India*, 73: 13-22.

Tikader, B.K. & Gajbe, U.A. 1977c. Taxonomic studies on some spiders of the genera *Drassodes* Westring, *Haplodrassus* Chamberlin, *Geodrassus* Chamberlin and *Nodocion* Chamberlin (family: Gnaphosidae) from India. *Records of the Zoological Survey of India*, 73: 63-76.

Tikader, B.K. & Gajbe, U.A. 1977d. A new species of spider of the genus *Eilica* (Gnaphosidae) from India.*Bulletin of the British Arachnological Society* 3(9, for 1976): 252-253.

Tikader, B.K. & Gajbe, U.A. 1979. Further studies on some spiders of the genus *Zelotes* Gistel (Araneae: Gnaphosidae) from India. *Bulletin of the Zoological Survey of India*, 2: 83-89.

Tiwari, A.K. & Singh, R. 2021. Diversity and distribution of Pisauridae (Araneae: Araneomorphae: Arachnida) in India. *International Journal of Entomology Research*, 6(1): 119-125.

Tiwari, A.K., Singh, G. & Singh, R. 2021a. Faunal diversity of Oonopidae (Araneomorphae: Araneae: Arachnida) in India. *Journal of Global Biosciences*, 10(1): 8340-8351.

Tiwari, A.K., Singh, G. & Singh, R. 2021b. Biodiversity of some poorly known families of spiders (Areneomorphae: Araneae: Arachnida) in India. *Journal of Global Biosciences*, 10(1): 8352-8371.

Tiwari, A.K., Singh, R. & Singh, G. 2021c. Diversity and distribution of Pholcidae (Araneae: Araneomorphae: Arachnida) in India. *International Journal of Life Sciences*, 9(1): 124-134.

Uniyal, V.P. 2006. Records of spiders from Indian trans-Himalayan region. *Indian Forester*, 132(12a): 177-181.

Uniyal, V.P. & Hore, U. 2009. *Effect of management practices on spider diversity in Terai Conservation Area (TCA)*. Final Project Report, Wild Life Institute of India. 222 pp.

Uniyal, V.P., Sivakumar, K. & Quasin, S. 2011. *Diversity of spiders in Nanda Devi Biosphere Reserve. Wildlife Institute of India, Dehradun*. DST Project Completion Report, 199 pp.

Vairale A.B. & Wagh, G.A. 2021. Diversity of spiders in microhabitats of a tropical reserve forest of Amravati, Maharashtra, India. *Bioscience Biotechnology Research Communications*, 14(1): 446-452.

Wolff, J.O., Řezáč, M., Krejčí, T. & Gorb, S.N. 2017. Hunting with sticky tape: functional shift in silk glands of araneophagous ground spiders (Gnaphosidae). *Journal of Experimental Biology,* 220(12): 2250-2259.

World Spider Catalog 2021. *World Spider Catalog*. Version 22.0. Natural History Museum Bern, online at http://wsc.nmbe.ch, accessed on 20 May 2021.

Yadav, A. 2019. Diversity and ecology of spiders in Champaner-Pavagadh Archaeological Park, a world heritage site in Gujarat. Ph.D. thesis, The Maharaja Sayajirao University of Baroda, Vadodara, Maharashtra, India.

Yadav, A., Solanki, R., Siliwal, M. & Kumar, D. 2017. Spiders of Gujarat: a preliminary checklist. *Journal of Threatened Taxa*, 9(9): 10697-10716.

Serket (2021) vol. 17(4): 474-480.

Redescription of *Rhagodinus caenaeicus* (Penther, 1913) (Solifugae: Rhagodidae) from Iraq

Azhar Mohammed AL-Khazali
Department of sciences, College of Basic Education, University of Sumer, Dhi Qar, Iraq
E-mail: azhararach@gmail.com

Abstract

Rhagodinus Roewer, 1933 is one of the small and rare genera within the family Rhagodidae. The species *R. caenaeicus* (Penther, 1913) was found again and redescribed herein on the basis of a new material collected near the type locality in Salah al-Din province in the centre of Iraq. All the main diagnostic characters are photographed and illustrated.

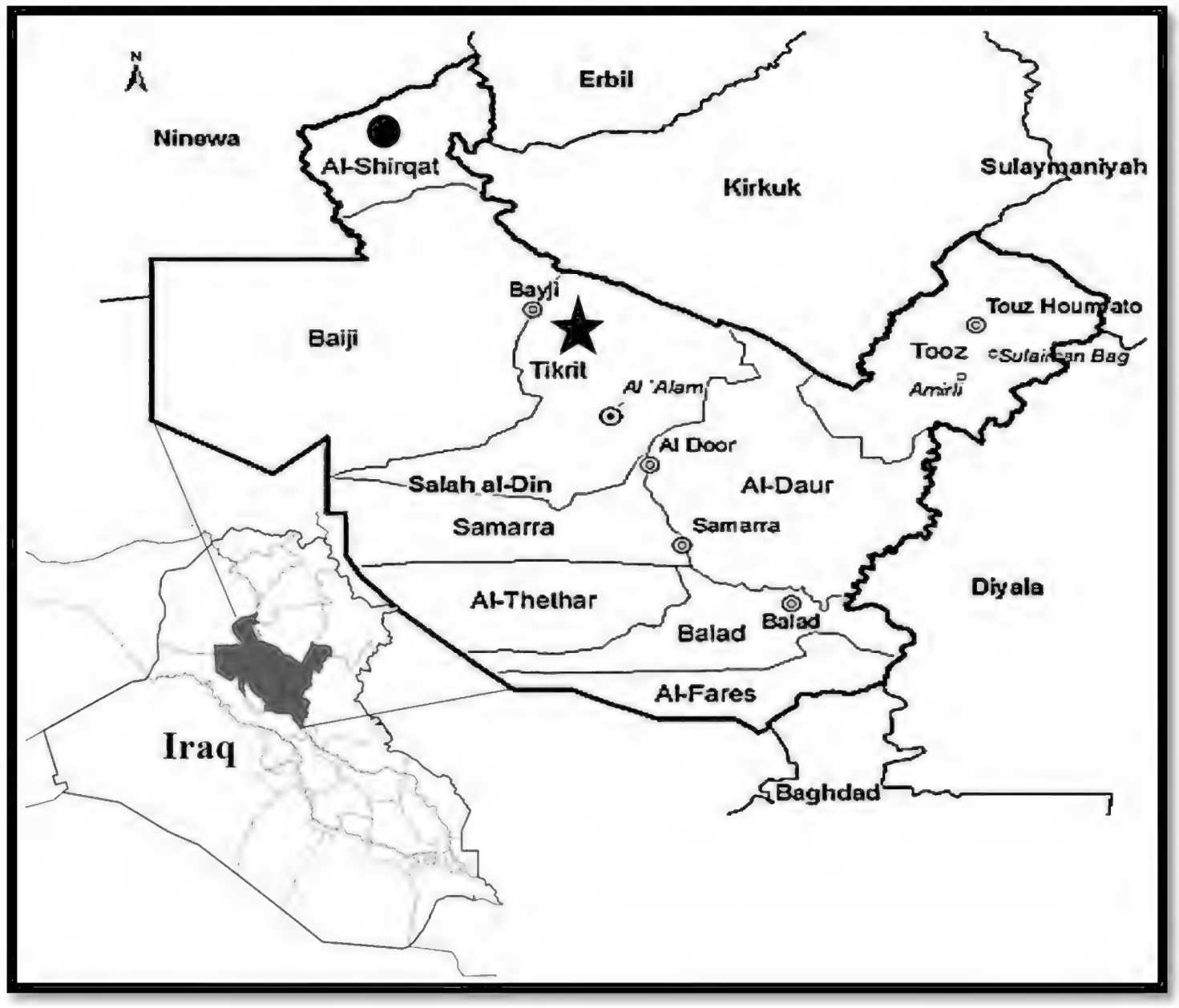
Keywords: Sun spider, Redescription, *Rhagodinus caenaeicus*, Iraq.

Introduction

Rhagodidae Pocock, 1897 is a large family of sun-spiders represented by 27 known genera (Harvey, 2003), distributed in semi-desert and arid habitats of north eastern Africa, South western Asia, and the Middle East. Rhagodids can be easily distinguished from all other solpugids by the unique hemispherical form of their anal segment while in other families it is terminally located (Roewer, 1933).

The fauna of Solifugae in Iraq is still poor studied and mostly unknown, according to Harvey (2003) there are 22 known species from Iraq, including five species of five genera belonging to the family Rhagodidae which are: *Rhagodia obscurior* (Penther, 1913), *Rhagodixa kurdistanica* (Birula, 1936), *Rhagodorta zorab* (Birula, 1905), *Rhagodospus babylonicus* (Birula, 1935), and the species *Rhagodinus caenaeicus*, which was described for the first time by Penther (1913) from Central Iraq under genus *Rhagodes*. Roewer (1933) transferred this species to the genus *Rhagodinus* which he establishes with other Rhagodid genera according to main generic diagnostic character, pattern of spinulation of the second, third, and fourth tarsi. Genus *Rhagodinus* consists of

only two species, *R. incertus* Caporiacco, 1937, known from Ethiopia and *R. caenaeicus* (Penther, 1913) known from Iraq and Palestine. Turk (1948) described it based on material from Palestine, and noted that the basic characteristics are identical with the descriptions of Penther (1913) and Roewer (1933), with some minor differences in colour. Since then, no data has been provided about this species, and the previous descriptions lack photos and detailed illustrations. In summer of 2017, while studying specimens of Solifugae, one rhagodid specimen was found and identified as *R. caenaeicus*, since then, despite many attempts, no other specimen was found. So the aim of this paper is to provide a redescription of *R. caenaeicus* enhanced with photos and illustrations, based on the material collected near the type locality (Map 1).



Map 1. Iraq map showing type locality (circle) and collecting locality (star) of *Rhagodinus caenaeicus* (Penther, 1913) in Salah al-Din province, centre of Iraq.

Material and Methods

A male specimen was collected from Tikrit district in Salah al-Din province, Iraq, (35°37'22.2"N, 43°15'04.0"E) (Fig. 1) at July, during night by hand. It was preserved in 70% ethanol. In the laboratory, it was fixed and examined under dissecting microscope model NTB-3A. Identification made by the keys of El-Hennawy (1990, 1999) and Roewer (1933). Photos were taken by digital camera installed on Olympus microscope. All measurements are in millimetres.

Abbreviations: CL = chelicera length, CW = chelicera width, PL = propeltidium length, PW = propeltidium width; A/CP: sum lengths of the pedipalp, leg I and leg IV (A) divided by the sum of length of the propeltidium and chelicera (CP) indicating length of legs in relation to body size. These ratios were calculated as defined by Muma (1951) and Brookhart & Muma (1981).

Figs. 1-7. *Rhagodinus caenaeicus* (Penther, 1913) ♂. 1-3. Habitus. 1-2. dorsal view (1. alive). 3. ventral view. 4-5. Right pedipalp. 4. prolateral view. 5. dorsal view. [so = suctorial organ] 6-7. Left leg. 6. prolateral view. 7. ventral view.

Taxonomy

Family **Rhagodidae** Pocock, 1897

Rhagodinus Roewer 1933
Rhagodes caenaeicus Penther, 1913: 107-108; Kästner, 1933-1935: fig. 347.
Rhagodes (Rhagadima) caenaeicus Penther: Roewer, 1932: fig. 136.
Rhagodinus caenaeicus (Penther): Roewer 1933: 279; Zilch, 1946: 121; Turk, 1948: 264; Levy & Shulov, 1964: 103.

Rhagodinus caenaeicus (Penther, 1933) Figs. 1-26.

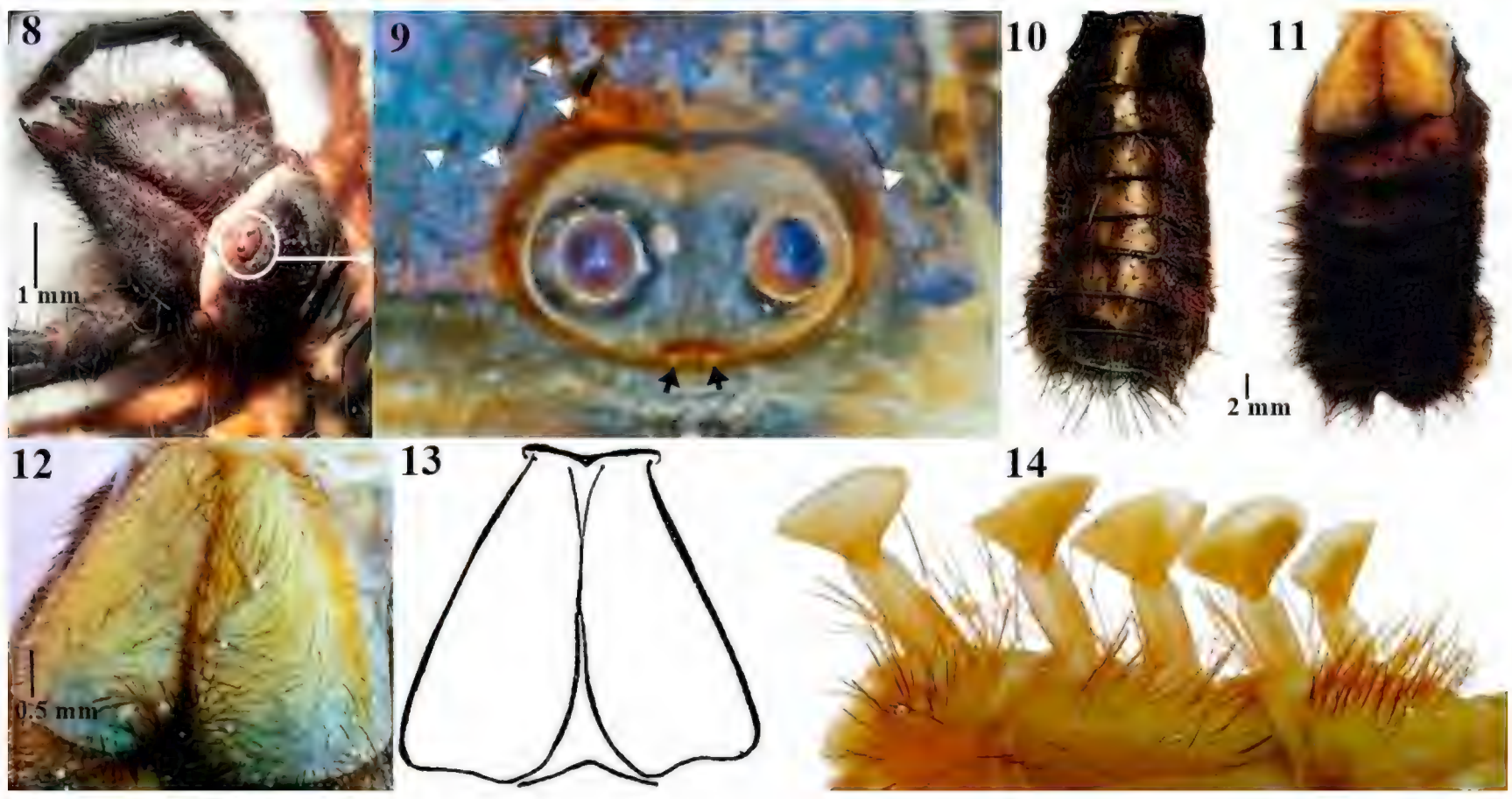
Morphological characteristics

Material examined. IRAQ, Salah al-Din Province: 1♂, Tikrit District, 35°37'22.2"N, 43°15'04.0"E, 20.Jun.2017, A. M. Al-Khazali leg**.**

Diagnosis. *Rhagodinus caenaeicus* can be easily distinguished from the only other species within this genus, *R. incertus*, and other closely species of Rhagodidae by general colouration. As well as the main characters in the original description, see Penther (1913).

Description

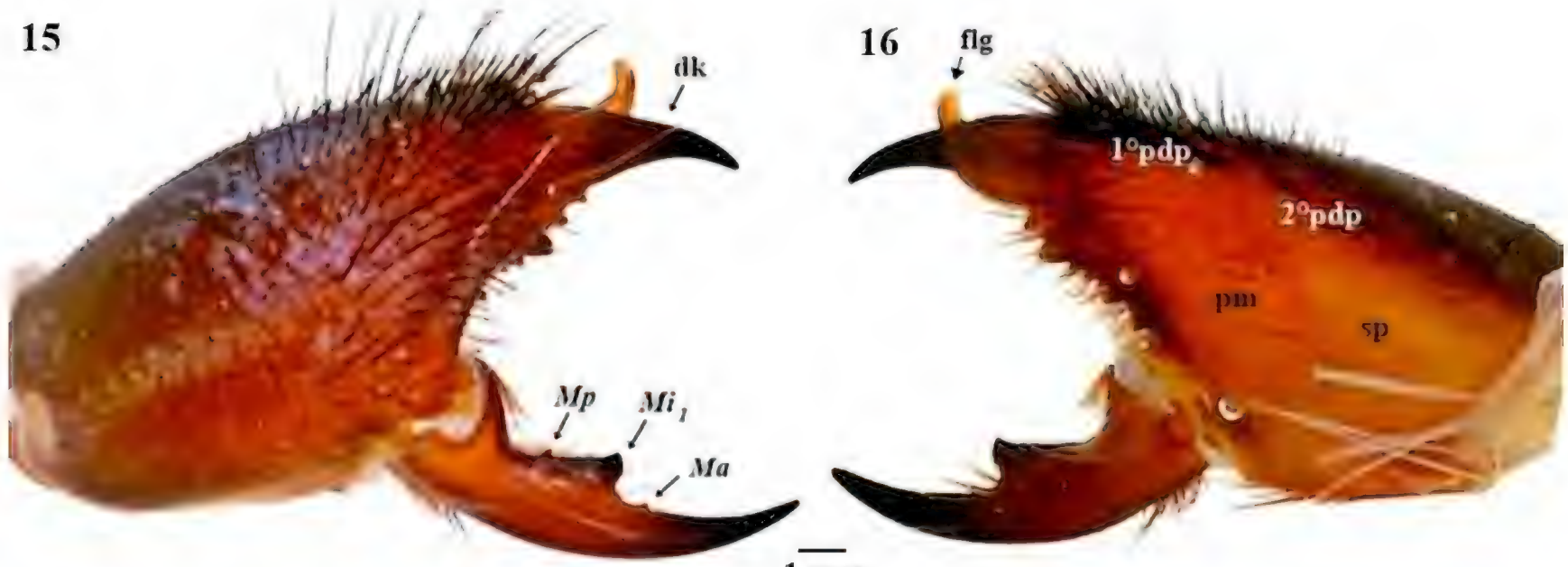
Colouration. Overall colour as described by Penther (1913): **Prosoma,** Propeltidium wider than long, dark brown, covered with short bristles black, anterolateral propeltidial lobe white, ocular tubercle elongated, yellowish brown with median eyes separated by less than one diameter, with two small spherical bulges yellow colour at the middle of the distal edge of ocular tubercle near anterolateral propeltidial, and fine short and thick bristles slightly above ocular tubercle. Pedipalps and first pairs of legs uniformly black-brown, except for the tarsus of the first pair of legs lighter in colour, both are densely covered with short and long brown-black bristles like spines, suctorial organ white (Figs. 1-9). The ventral side of metatarsus in leg I has elongated oval white spot, extending the proximal part to farther from middle metatarsus, it may represent adhesion organs (Fig. 7). Mesopeltidium and metapeltidium dorsally black, laterally yellow. **Opisthosoma**. Overall black, dorsal plates with a few sparse hairs, semi-smooth compared with lateral and ventral sides which are covered with long thick reddish brown hair, genital operculum yellow, almost triangular similar wings, malleoli yellow (Figs. 10-14).

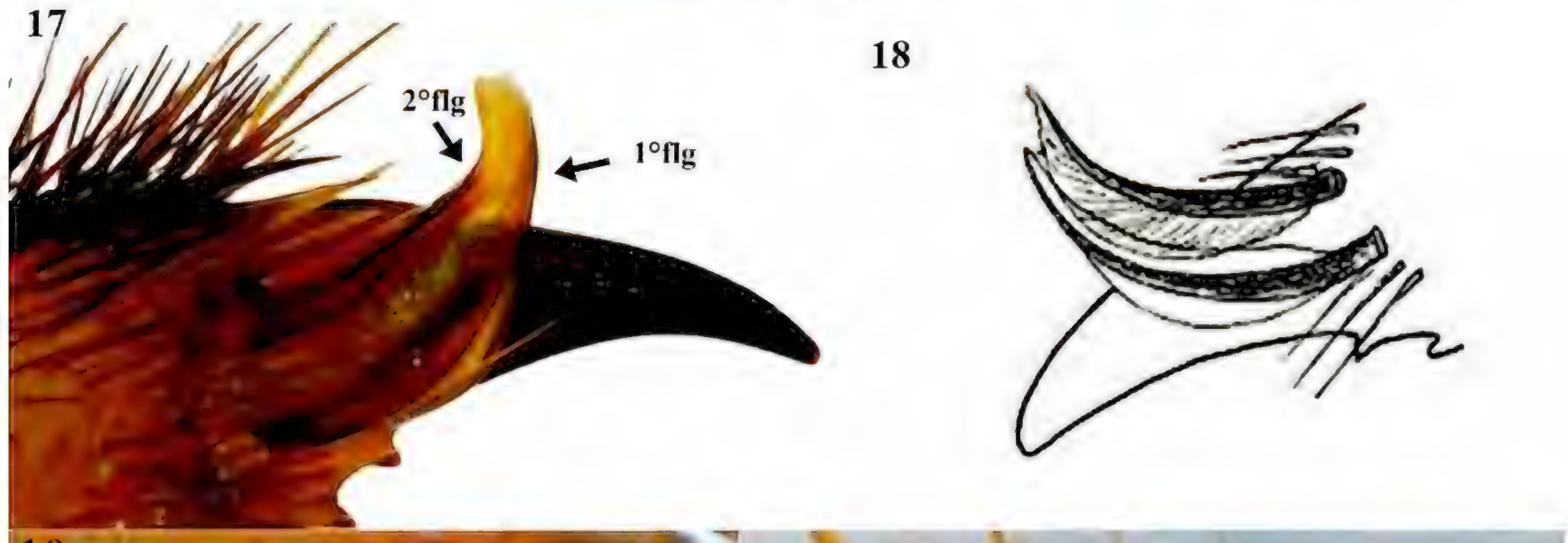


Figs. 8-14. *Rhagodinus caenaeicus* (Penther, 1913), ♂. 8. Propeltidium and chelicerae, dorsal view. 9. Detail (from 7) of the ocular tubercle [White Triangles = bristles like spines, Black Arrows = spherical bulges]. 10-11. Opisthosoma. 10. dorsal view. 11. ventral view. 12-13. Genital operculum. 14. Malleoli on leg IV.

Chelicerae uniformly coloured, dorsally black-brown, laterally reddish brown, covered with long and short black setae, ventrally yellowish brown, reddish brown in median part and dark brown in distal part; fingers and teeth dark brown (Figs. 15-16); Flagellum reddish brown, and its free end yellowish brown, visible in retrolateral view of chelicera, tube-like (diploflagellum) composed of two intertwined concave flagella, primary and secondary flagellum almost equal length (Figs. 17-18). *Dentition*. Movable finger with three teeth, one large medial main tooth, one very small anterior tooth, one small prolateral tooth, fixed finger with 11 teeth, two smaller anterior teeth and one main tooth, three retrofondal apical teeth graded in size from distal to proximal III-II-I; and three profondal teeth, comprising one very small medial tooth, one proximal and one sub-proximal tooth approximately equal in size; cheek part with two large ectal teeth (Figs.

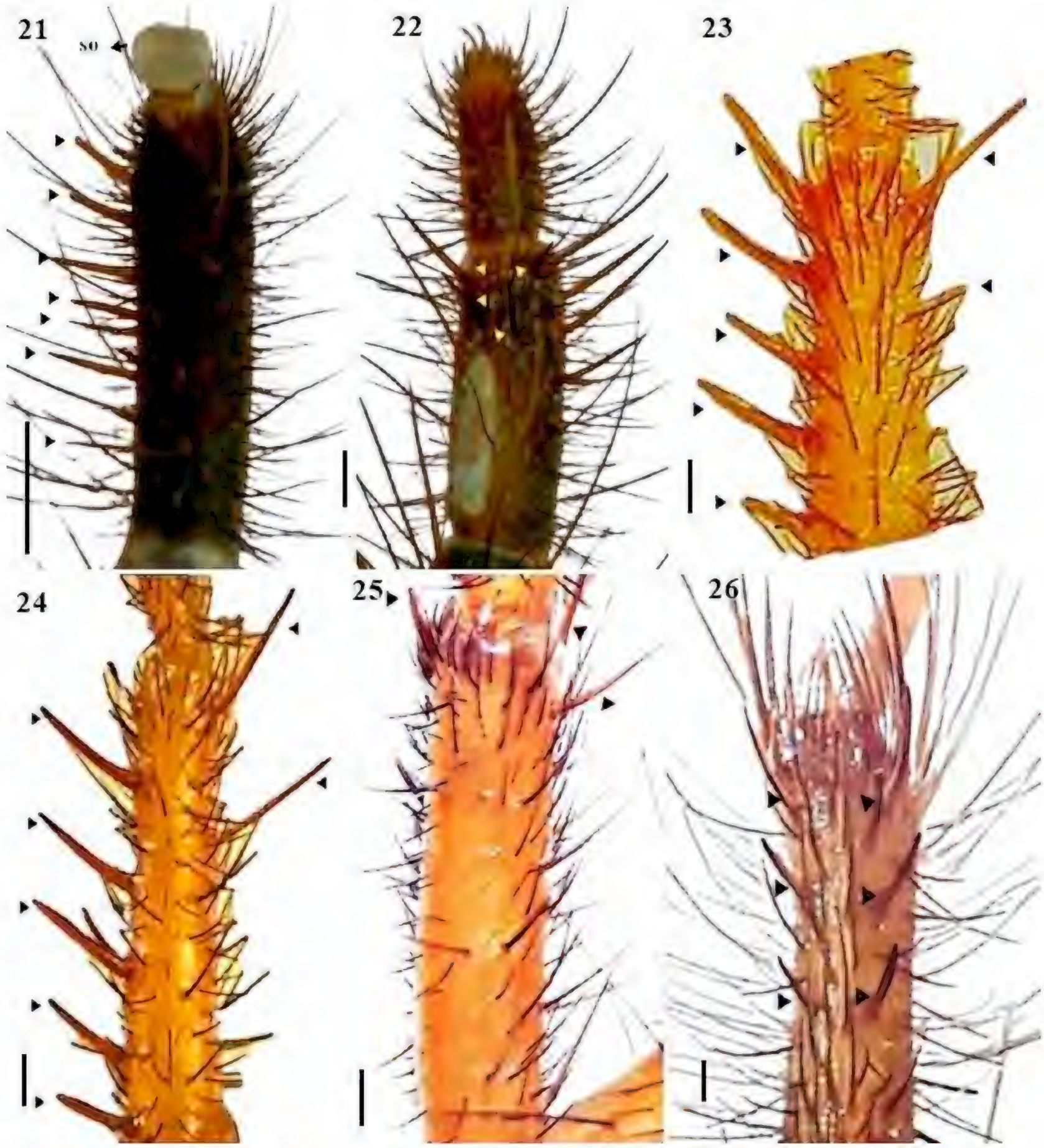
19-20). Legs II-IV uniform in yellow colour covered with less dense brown bristles than in the pedipalps and first pair of legs.





Figs. 15-20. Left chelicera of *Rhagodinus caenaeicus* (Penther, 1913) ♂. 15. retrolateral view. 16-17. prolateral view (17. enlarged). 18. After Roewer (1933) for comparison. 19. Teeth on fixed finger. 20. Teeth on movable finger.
Abbreviations: flg = flagellum; 1°pdp, 2°pdp = primary and secondary prodorsal proximal setae, respectively; pm = promedial setae; sp = stridulatory plate; 1°flg, 2°flg = primary and secondary, respectively; dk = dorsal keel; Movable finger: anterior tooth (*Ma*), intermediate teeth (*Mi1–2*) and principal tooth (*Mp*).

Measurements. Total length 35.6; PL 2.8, PW 4.6, PW/PL 1.64; CL 10.5, CW 4.1, CL/CW 2.62; A/CP 3.62; Ocular tubercle length 0.9, width 1.3; Palp 25.4 (7.2, 6.1, 6.6, 1.1). Leg I: 17.5 (3.5, 4.1, 3.1, 2.5, 0.5), Leg IV: 31.4 (6.5, 7.1, 5.2, 3.1, 2.4).



Figs. 21-26. *Rhagodinus caenaeicus* (Penther, 1913) ♂, spines on appendages segments. 21. tarsus of pedipalp. 22. tarsus and metatarsus of leg I. 23-24. metatarsus of leg II, III, respectively. 25. tibia of leg II. 26. tarsus of leg IV.
Arrows = Spines], (Scale bars: 0.2 mm).

Spination of appendages. Leg I: tarsus short without spines but contains numerous thin long hairs, metatarsus ventrally with 2.2. brown spines and 1.1.1.1 bristles like-spines on retrolateral, on the near side of tarsus; it is worth mentioning, there is a pale white spot on ventrally surface of metatarsus in the near half of the tibia. Legs II and III: tarsus without spines, metatarsus dorsally with 1.1.1.1.1.1, ventrally with 1.1 longer and thinner than dorsal spines, located in proximal part of tarsus. Tibia, dorsally with 1 spine on distal apical near of metatarsus. Leg IV: tarsus ventrally with 2.2.2, metatarsus with 2.1 spines, tibia dorsally, with 5-6 long bristles like-spines, ventrally with 1.1 thicker and shorter than dorsal bristles located in distal part. Pedipalps, metatarsus with 2.2.2.2.2.2.2 pairs of spines (four ventral-lateral and three on the ventral midline) and all parts with numerous sensory setae (Figs. 21-26).

Comments

The body colour pattern is mainly used to describe rhagodid species. Turk (1960), and Reddick (2008) mentioned that the colour pattern of most rhagodid species is constant. Penther (1913) mainly relied on the colour pattern in the original description of *R. caenaeicus*. The specimens of this species described having distinctive and unique colouring pattern different from other closely species of Rhagodidae. The studied specimen's colour pattern perfectly match in all details with original description. Thus, this study could mainly rely on colour pattern for distinguishing this species from other closely related species of Rhagodidae.

Acknowledgments

My gratitude and appreciation to the Egyptian scientist Hisham K. El-Hennawy to provide scientific advice. My gratitude to my dear brother, Montazer to his help to obtain specimens.

References

Brookhart, J.O. & Muma, M.H. 1981. The *pallipes* species-group of *Eremobates* Banks (Solpugida: Arachnida) in the United States. *The Florida Entomologist*, 64(2): 283-308.

El-Hennawy, H.K. 1990. Key to Solpugid Families (Arachnida : Solpugida). *Serket*, 2(1): 20-27.

El-Hennawy, H.K. 1999. Sun-spiders of the Arab countries (Arachnida : Solpugida). *Serket*, 6(3): 73-104.

Harvey, M.S. 2003. *Catalogue of the smaller arachnid orders of the world. Amblypygi, Uropygi, Schizomida, Palpigradi, Ricinulei and Solifugae*. xi+385 pp. CSIRO Publishing, Collingwood, Australia.

Muma, M.H. 1951. The arachnid order Solpugida in the United States. *Bulletin of the American Museum of Natural History*, 97(2): 31-142.

Penther, A. 1913. Solifugae. In Wissenschaftliche Ergebnisse der Expedition nach Mesopotamien, 1910. *Annalen des K. K. Naturhistorischen Hofmuseums*, 27: 107-108.

Reddick, K.L. 2008. The diversity, distribution and feeding behavior of solifuges (Arachnida;Solifugae) in Kenya. Texas A&M University: M.Sc. thesis. xiv+146 pp.

Roewer, C.F. 1933. Solifugae, Palpigradi. *In* E.G. Bronn (editor), *Klassen und Ordnungen des Tierreichs. 5: Arthropoda. IV: Arachnoidea und kleinere ihnen nahegestellte Arthropodengruppen*. Vol. 5(IV) (4) (2-3): 161-480. Leipzig: Akademische Verlagsgesellschaft M.B.H.

Turk, F.A. 1960. On some sundry species of solifugids in the collections of the Hebrew University of Jerusalem. *Proceedings of the Zoological Society of London*, 135(1): 105-124.

Serket (2021) vol. 17(4): 481-486.

Micrommata formosa in Jordan (Araneae: Sparassidae)

Hisham K. El-Hennawy [1] & Mohammad Al-Saraireh [2]
[1] 41 El-Manteqa El-Rabia St., Heliopolis, Cairo 11341, Egypt
[2] Oncology Department, Royal Medical Services, Amman, Jordan
* Corresponding author e-mail address: el_hennawy@hotmail.com

Abstract

Micrommata formosa Pavesi, 1878 of family Sparassidae is recorded from Jordan for the first time. Only one female specimen of this species was collected in January 2020 from Motanazah El-Baydah, Al Hussain national park in Al Qattar Valley, south of Amman, Jordan.

Keywords: Araneae, Sparassidae, *Micrommata formosa*, Jordan.

Introduction

Genus *Micrommata* Latreille, 1804 is one of the small genera of family Sparassidae Bertkau, 1872 which includes 1287 species in 87 genera. The valid species of genus *Micrommata* are 6 species in addition to 1 subspecies; they are mainly distributed in the Mediterranean countries to Central Asia and Far East, in addition to one species from South Africa (World Spider Catalog, 2021):

Micrommata aljibica Urones, 2004 ♂♀ Spain
Micrommata aragonensis Urones, 2004 ♀ Spain
Micrommata darlingi Pocock, 1901 ♀ South Africa
Micrommata formosa Pavesi, 1878 ♂♀ Spain, northern Africa, Italy (Sicily), Cyprus, Israel (= Palestine)
Micrommata ligurina (C.L. Koch, 1845) ♂♀ Mediterranean to Central Asia
Micrommata virescens (Clerck, 1757) * ♂♀ Europe, Turkey, Caucasus, Russia (Europe to Far East), Iran, Central Asia, China, Korea, Japan
Micrommata virescens ornata (Walckenaer, 1802) ♂♀ Europe, Syria, Israel (= Palestine)

Its type species is *Micrommata virescens* (Clerck, 1757) which is widely spread more than other species (see above). In the Middle East, two species of *Micrommata* are recorded: *M. formosa* and *M. ligurina* (Levy, 1989).

Fig. 1. Map and photograph of the place where the studied female *Micrommata formosa* was found.

Taxonomic references

Micrommata formosa Pavesi, 1878: 348-350 (Dj); Simon, 1880a: 284-285 (Nj). Italy (Lampedusa, Sicily)
Micrommata ophthalmica Simon, 1880a: 285-286 (D♂♀). Algérie: Sétif (Lataste), Tlemcen (L. Bedel).

Micrommata ophthalmica Simon, 1880b: LXIV (64) (D♂). Algérie: Tlemcen (rapporté par M. L. Bedel).
Micrommata formosa Kulczyński, 1911: 36, pl. 1, f. 38 (D♂). Palaestina.
Micrommata formosa Strand, 1913: 160 (D♀). Ein ♀ von Rehoboth-Jaffa.
Micrommata formosum Levy, 1989: 165-167, f. 100-114 (♂♀, S). Algeria, Tunisia, Libya, Lampedusa Island, Israel (p.166: several localities).
Micrommata formosa Breitling, 2020: 356, f. 33A (♀). Spain.

Records and distribution of *Micrommata formosa* according to Nentwig *et al.* (2021) in addition to World Spider Catalog (2021):

Spain (Breitling, 2020), Northern Africa: Algeria, Tunisia, Libya (Simon, 1880a,b; Bosmans, unpubl.), Italy: Lampedusa, Sicily (Pavesi, 1878; Pantini & Isaia, 2019), Cyprus (Bosmans *et al.*, 2019), Israel (= Palestine) (Kulczyński, 1911; Strand, 1913; Levy, 1989).

In Jordan, only two species of two genera of Sparassidae are recorded:
1- *Cerbalus aravaensis* Levy, 2007 from the conterminous southern Arava Valley; West Wadi Sik, Rahma, Qatar area (Levy, 2007; El-Hennawy, 2020).
2- *Eusparassus walckenaeri* (Audouin, 1825) from Dana Natural Reserve, Wadi Dana; Petra, Al-Habis; Amman, Pine forest; Al-Bala, 10 km southeast of Suwaylih, Al-Fuhays (Moradmand & Jäger, 2012) [and Jordan without definite locality by Levy (1989)].

The studied specimen is an adult female *Micrommata formosa* Pavesi, 1878 found in Motanazah El-Baydah, Al Hussain national park in Al Qattar Valley, south of Amman, Jordan on 10th January 2020. It was moving on ground among short herbs and plants albeit the weather was very cold.

Family **Sparassidae** Bertkau, 1872
Genus ***Micrommata*** Latreille, 1804
Micrommata formosa Pavesi, 1878 (Figs. 2-11)

World Distribution: Spain, northern Africa, Italy (Sicily), Cyprus, Israel (= Palestine) (World Spider Catalog, 2021).

Material examined. Jordan, 1♀, Motanazah El-Baydah, south of Amman (31°56'40"N, 36°02'35"E, elev 795 m), Al Hussain national park in Al Qattar Valley, 10 January 2020, leg. Mohammad Al-Saraireh [ACE.2020.01.10.AR.001.JOR].

For a description of *Micrommata formosa* see Levy (1989: 165-167, f. 100-114).

Measurements (in millimetres):
Total length 9.9; Cephalothorax length 4.0, width 3.5; Abdomen length 6.1.

Table 1. Measurements of leg segments of *Micrommata formosa* (♀).

Leg	Femur	Patella + Tibia	Metatarsus	Tarsus	Total
I	3.8	4.2	3.0	1.0	12.0
II	4.0	4.5	3.0	1.0	12.5
III	3.6	3.2	2.0	0.9	9.7
IV	4.1	3.0	3.0	1.0	11.1

Legs 2143

2

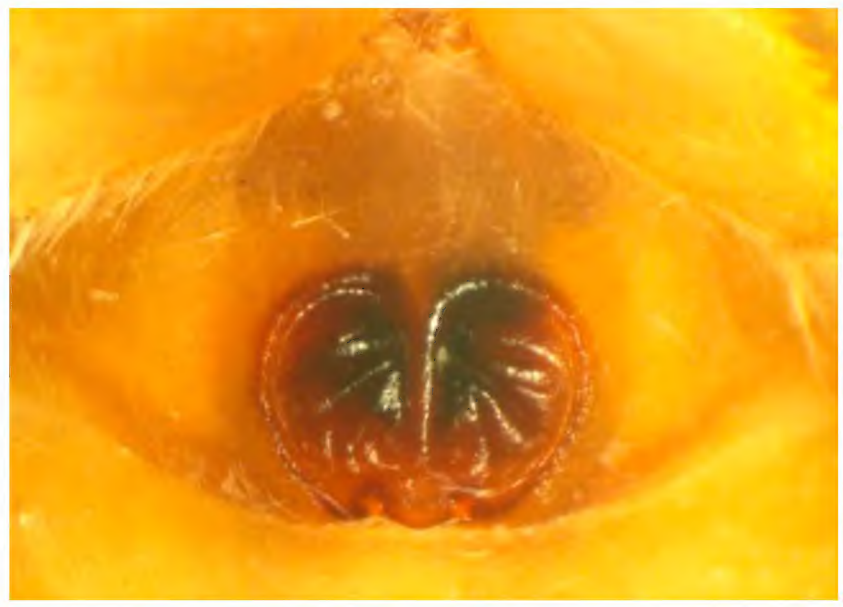
4

3

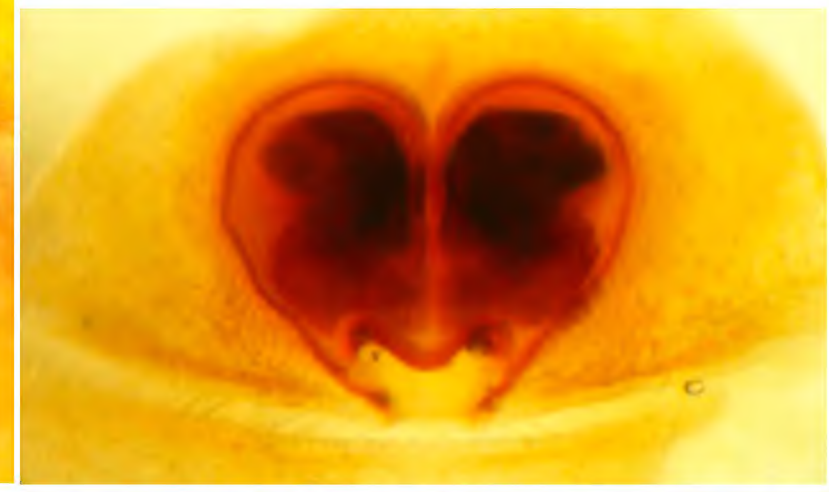
5

Figs. 2-5. *Micrommata formosa* Pavesi, 1878 ♀. 2-3. Habitus, dorsal view. 2. alive. 3. preserved *. 4. cephalothorax, dorsal view. 5. abdomen, dorsal view.

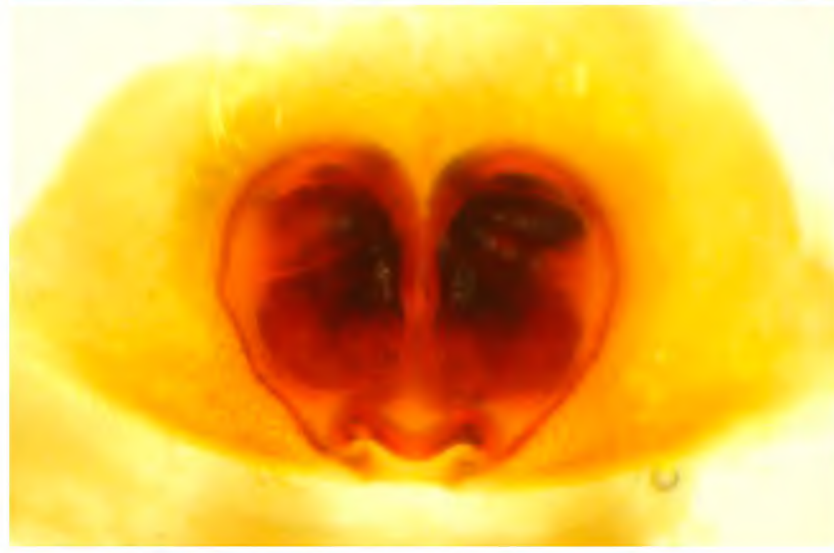
* Levy (1989) said that: "*Micrommata* species have a bright green coloration occasionally with scarlet lines, but hues are lost on immersion in liquid." (p.128), "*Micrommata*, the green sparassids, .. Colours vanish very soon on preservation." (p.163).



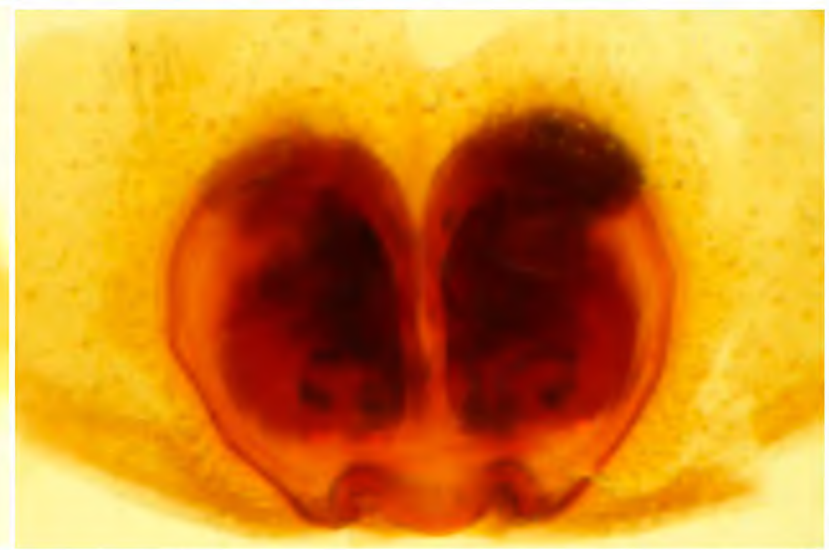
6



7

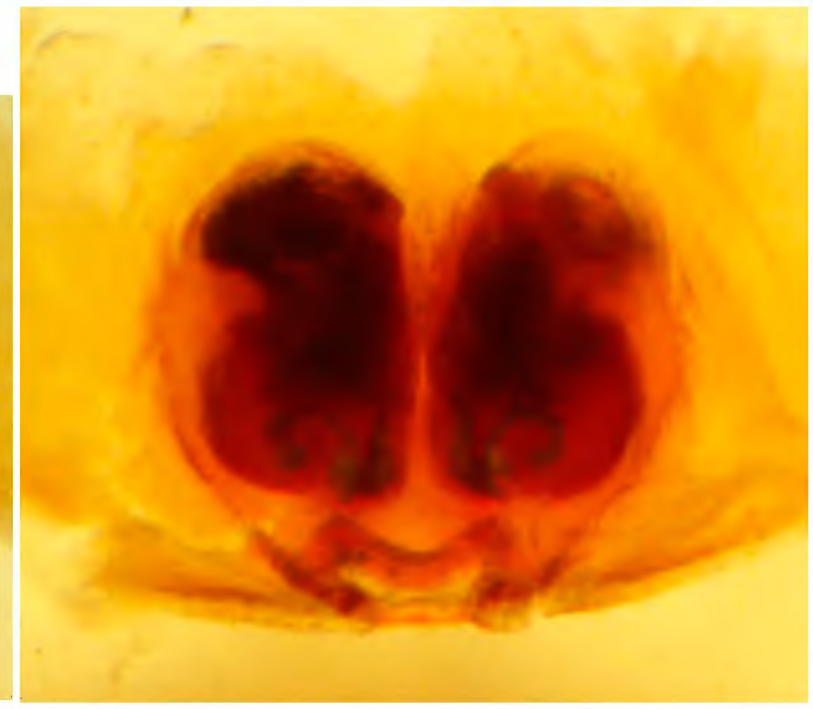


8



9

10



11

Figs. 6-11. *Micrommata formosa* Pavesi, 1878 ♀, epigynum. 6. in the abdomen. 7-11. separated and cleared. 6-9. ventral view. 10-11. dorsal view.

Notes on the identification of sparassids especially females of *Micrommata*:

"In the absence of adequate drawings and owing to erroneous placement of species, material from a great many sites in adjacent countries and from other faunae had to be examined. (Levy, 1989: 129)"

"Unfortunately, the available figures for the females of several of the known species do not allow a confident discrimination from *M. formosa*, given the major ontogenetic variation of epigynal structures, and the genus appears in need of a thorough revision. (Breitling, 2020: 356)"

Acknowledgment

We are grateful to our enthusiast colleague Bassam Abu Afifeh (Ministry of Education, Al Rumman Secondary School, Amman) for his great interest in studying spiders and scorpions of Jordan and for his kind help to obtain specimens.

References

Bosmans, R. (unpubl.) Provisional list of spiders of North Africa. Database excerpt Aug. 2019.

Bosmans, R., Van Keer, J., Russell-Smith, A., Hadjiconstantis, M., Komnenov, M., Bosselaers, J., Huber, S., McCowan, D., Snazell, R., Decae, A., Zoumides, C., Kielhorn, K.-H. & Oger, P. 2019. Spiders of Cyprus (Araneae). A catalogue of all currently known species from Cyprus. *Newsletter of the Belgian arachnological Society*, 34(Supplement): 1-173.

Breitling, R. 2020. South European spiders from the Duffey collection in the Manchester Museum (Arachnida: Araneae). *Arachnology*, 18(4): 333-362.

El-Hennawy, H.K. 2020. *Segestria florentina* (Rossi, 1790) in Jordan (Araneae: Segestriidae), with a list of the known records of spiders from Jordan. *Serket*, 17(3): 314-323.

Kulczyński, W. 1911. Fragmenta Arachnologica. XVI, XVII. *Bulletin International de l'Academie des Sciences de Cracovie*, 1911: 12-75.

Levy, G. 1989. The family of huntsman spiders in Israel with annotations on species of the Middle East (Araneae: Sparassidae). *Journal of Zoology, London*, 217(1): 127-176.

Levy, G. 2007. *Calommata* (Atypidae) and new spider species (Araneae) from Israel. Zootaxa, 1551, 1-30.

Moradmand, M. & Jäger, P. 2012. Taxonomic revision of the huntsman spider genus *Eusparassus* Simon, 1903 (Araneae: Sparassidae) in Eurasia. *Journal of Natural History*, 46(39-40): 2439-2496.

Nentwig, W., Blick, T., Bosmans, R., Gloor, D., Hänggi, A. & Kropf, C. 2021 Spiders of Europe. Version 05.2021. Online at https://www.araneae.nmbe.ch, accessed on {May 2021. [https://araneae.nmbe.ch/data/2927/Micrommata_formosa]

Pantini, P. & Isaia, M. 2019. Araneae.it: the online catalog of Italian spiders, with addenda on other arachnid orders occurring in Italy (Arachnida: Araneae, Opiliones, Palpigradi, Pseudoscorpionida, Scorpiones, Solifugae). *Fragmenta Entomologica*, 51: 127-152.

Pavesi, P. 1878. Nuovi risultati aracnologici delle Crociere del "Violante". Aggiunto un catalogo sistematico degli Aracnidi di Grecia. *Annali del Museo Civico di Storia Naturale di Genova*, 11: 337-396.

Simon, E. 1880a. Révision de la famille des Sparassidae (Arachnides). *Actes de la Société Linnéenne de Bordeaux*, 34(2/3/4): 223-351.

Simon, E. 1880b. Description de *Micrommata ophthalmica* et de *Cebrennus pulcherrimus*, d'Algérie. *Annales de la Société Entomologique de France* (5) **10**(Bull.): 64-65.

Strand, E. 1913. Erste Mitteilung über Spinnen aus Palästina, gesammelt von Herrn Dr J. Aharoni. *Archiv für Naturgeschichte* **79**(A10): 147-162.

World Spider Catalog 2021. *World Spider Catalog*. Version 22.0. Natural History Museum Bern, online at http://wsc.nmbe.ch, accessed on May 2021.